Tiija Rinta

Supervisors: Graham F. Welch and Johan Sundberg

Connections between children's speaking and singing behaviours: implications for education and therapy

2008

Doctoral Thesis from the Department of Arts and Humanities, Music Division, Institute of Education, University of London

Abstract

The purpose of the study was to investigate potential connections between children's speaking and singing behaviours, as well as to explore the potential use of such connections in speech or voice therapy and in educational settings. The objectives of the study were addressed through an exploratory approach.

In the literature review, potential connections between the two vocal behaviours were investigated theoretically from the physiological (including neurological), voice-developmental, psychological and sociological perspectives. Based on the theorising, a model of children's vocal functioning was generated. The model advocates the interconnectedness of all vocal functioning and provides arguments towards the idea of musical elements possessing an enhancing effect on children's vocal functioning.

In the empirical phase of the study, the theoretical model was exposed to empirical testing. The pre-pilot study consisted of interviews with eight professional speech and voice therapists. The procedure for the pilot and the main studies consisted of: voice recordings, questionnaires, interviews, observations and a psychological test. The procedure was conducted with four classes of children. Initially, all the participants were treated as one group and, subsequently, each class was looked at separately and treated as a case-study. In total, 76 7-10-year old children participated. In addition, interviews were carried out with the teachers of each class.

Both quantitative and qualitative analyses were used. The main findings were that children's speaking and singing behaviours are connected through physiological, psychological and sociological routes, but not through the developmental route. Particularly strong evidence for the interconnectedness of the vocal behaviours was found from the voice-scientific, psychological and sociological perspectives. The findings imply that children's speaking and singing behaviours are related and, therefore, it may be possible to enhance the quality and functioning of one vocal behaviour through the other. The findings also imply that children's vocal health is connected to a variety of holistic factors and that singing can potentially be used as a means to target these factors. Such findings have significant implications for both educational and therapeutic practice.

Acknowledgements

I would like to thank my supervisors Graham Welch and Johan Sundberg for their guidance, encouragement and continual support throughout my research journey. I would also like to thank all the academics and research colleagues that I have come to know. The stimulation and intellectual challenges faced during numerous conversations and sessions in the academic environment of the Institute greatly assisted me in doing my doctoral thesis.

I would like to thank all of my research colleagues who helped me with statistics and other research methods. A special thank you goes to Evangelos Himonides and Ioulia Papageorgi for all their assistance.

A huge thank you goes to all the teachers, therapists and children that participated in the study. In particular, thank you to Steve Harrison for all the support he provided throughout the study. A special thank you goes to the teachers at the Finnish school who were particularly supportive throughout the study, not only during their own involvement.

I would like to thank my family for their support and encouragement.

I would like to thank all the inspiring and wonderful people that I have met during this phase of my life. I would like to thank all of my current and previous flatmates for lightening up the atmosphere during leisure time. I would specifically like to thank all of those who became more than just flatmates and provided me with great support throughout: Hua, Mabel, Sumaye, Jenni, Kumiko and Sakurako.

I would like to thank all of my old and new friends for always being there. In particular, I would like to thank Vicky for listening, Ahmed for being the big brother, Sidra for being close although far, Jack for the metta, Filipe for the being the other brother, Shilpa for the spiritual input, Ismail for being a strong shoulder to lean on, Maria for the supportive friendship, Kirsti for providing alternative perspectives to life and Valerie for understanding my way of thinking.

It would not have been possible to undertake this piece of work without the financial assistance from the Economics and Social Research Council, the Finnish Cultural Foundation and the Finnish Government.

I declare that the work presented in this thesis is my own. I declare that the length of the thesis is 79, 732 words.

Tiija Rinta

30/4/08

Index

Abstract

Acknowledgements

Chapter 1: Introduction

Chapter 2: The child voice

Chapter 3: Connections between speaking and singing behaviours: potential exploitation of such connections in education and therapy

Chapter 6: Findings from a physiological perspective

Chapter 7: Findings from a vocal developmental perspective

Chapter 8: Findings from a psychological perspective

Chapter 9: Findings from a sociological perspective

Chapter 10: Discussion

List of Figures

Chapter 2:

Chapter 3:

Chapter 4:

Chapter 5:

Chapter 6:

Chapter 7:

Chapter 8:

Chapter 9:

Chapter 10:

Chapter 11:

List of Tables

Chapter 2:

Chapter 5:

Chapter 6:

Chapter 8:

Chapter 9:

Chapter 1: Introduction

1.1 Background

I have been interested in human vocal functioning since a very young age. Having grown up in a reserved Scandinavian culture where vocal expression is limited, yet the tradition of choral singing is wide-spread (Durrant, 2003), one learns to view speaking and singing activities as completely separate from one another. Speaking does not serve much of an emotionally-expressive function and a number of individuals speak only when they absolutely have to: a casual chat does not necessarily take place very easily (Einarsdottir, 2006). Singing, on the other hand, serves an important expressive and social function in the individuals' lives who participate in formal choral singing sessions (Grape et al., 2003). Singing activities are generally viewed as a forum for emotional expression and for connecting with others in social settings.

In Scandinavian schools and the society in general, speaking and singing behaviours are regarded as two completely different sets of behaviours. In schools, singing is traditionally regarded as a novel activity that only individuals who are able to sing well can engage in. Generally, singing only takes place in choral sessions once a week (Ministry of Education, 2007). Outside the singing sessions, the majority of the singers do not sing, except perhaps on their own at home. The whole idea behind the singing sessions is that only the selected, talented singers can participate and exercise their 'special skill'. Such a distinction between 'singers' and 'non-singers' draws clear lines between individuals. As a result of the differentiation, 'non-singers' are often found to possess poorer vocal identity, lower self-esteem and to demonstrate a lack of enjoyment in any musical activity (Grape et al., 2003), based on local observation and discussions with such individuals.

Fortunately, my own family visited a number of countries when I was growing up. During those visits, it occurred to me that voice use and singing activities vary a great deal between different cultures. For example, in Italy and Morocco, singing forms a part of everyone's daily life. One could hear singing when walking down the streets. People sang to themselves whilst carrying out daily chores (Cross, 2002; Welch, 2005). In these cultures, there did not seem to be as strong a distinction between speaking and singing behaviours: rather, both vocal behaviours were regarded as being part of daily life through serving an equally communicative function. There was little distinction between 'singers' and 'non-singers'. The majority of people enjoyed using their voices through a variety of vocal activities.

In those cultures where everyone was engaged in singing, people seemed to have developed more positive perceptions on their voices, as evidenced in the fact that these individuals thoroughly enjoyed exploiting their voices in a number of ways (Clift and Hancox, 2001). Such cultural activities were a total contrast to the Scandinavian culture where voice use was more limited. On the basis of this discovery, I started wondering whether the distinction between speaking and singing behaviour was beneficial for healthy vocal development. In my opinion, and based on observation, such a distinction seemed to inhibit rather than enhance one's overall vocal functioning and one's attitude towards one's voice.

My interest in healthy vocal functioning intensified during my professional career. I recall a number of professional experiences, which highlighted the importance of healthy vocal functioning. For example, I used to work for kindergartens catering for children with special needs. I discovered that those who possessed a form of psychological or physical disability, which did not interfere with their vocal functioning, seemed to have a healthier and more positive view of themselves than those whose vocal functioning was affected by their disability (Baker, 2002a; b; Rinta, 2008). I also noticed that, unfortunately, the children whose vocal functioning was distorted did not always receive appropriate attention or sufficient professional help for their difficulty.

The situation seemed to be the same in a number of mainstream schools in London and in Finland. There were quite a few children with speech or voice distortions in all year-groups, but such children did not receive any intervention for their distorted vocal behaviours. Only the most severe speech disorders received attention from adults, after which the sufferers were directed to a speech and language therapist. From my professional anecdotes, it became evident that there was a huge lack of knowledge amongst teachers, therapists and parents with regard to children's speech and voice disorders, speaking and singing behaviours, vocal functioning and voice quality. In particular, teachers did not seem to possess appropriate concepts of 'normal' and 'abnormal' characteristics of the child voice.

On continuing my academic studies, I decided to research children's vocal behaviours, mainly as a result of my own personal and professional experiences. I was amazed by the lack of research conducted in the field of voice. Much of the research had focussed on adults, with children having been under-represented (McAllister, 1997; Sederholm, 1996; White, 2001). Given the importance that has always been placed on early childhood experiences, this was a surprising finding. In particular, firstly having studied psychology, the connections between children's psychological sides and their vocal functioning through neurology attracted my attention. Such findings lead me to research the potential connections between the bodymind and children's vocal functioning (Thurman and Welch, 2000).

I became interested in investigating the potential impact of singing on children's voice quality in both speaking and singing behaviours due to the fact that there still seemed to be a noticeable divide between speaking and singing behaviours within the general public, particularly in Western countries (Welch, 2005). I set out to investigate whether a child was likely to feel more relaxed after having been engaged in singing activities and whether that would subsequently result in enhanced vocal functioning. At the same time, I started looking into the holistic nature of our vocal functioning (Thurman and Welch, 2000). The research area expanded once I started investigating it in more detail; I started exploring how a variety of factors may potentially influence one's vocal functioning and the quality of one's voice. At the same time, I started researching current approaches in speech and voice therapy practice. Based on such investigation, I started formulating my own theory on how speaking and singing behaviours may potentially be connected and how singing could potentially be exploited in speech and voice disorder treatment.

After discovering the lack of research in the field, I realised that, first, I needed to investigate how to define 'the normal' characteristics of the child voice before being able to conduct the study that I initially set out to carry out (i.e. potential exploitation of singing in speech and voice therapy treatment) (McAllister, 1997; Sederholm, 1996; White, 2001). In order to know what the characteristics of 'a normal' voice are, the voice needs to be assessed (Mathieson and Greene, 2003). Therefore, I started investigating such assessment procedures that are in current use amongst speech and voice therapists (Carding et al., 2000; Yamaguchi et al., 2003). I discovered that there were wide differences between practicing professionals as to how they went about such an essential task (McAllister, 1997; Sederholm, 1996). In addition, I discovered that the definitions for 'normal' and 'abnormal' characteristics in speaking and in singing behaviours were relatively vague, indicating that therapists may possess subjective ideas as to when a voice can be classified as disordered (Spyer, 2007). It was a surprising finding to realise that there were no common guidelines as to speech and voice therapy practice between individual speech and voice therapists within and across countries. With regard to voice assessment procedures and therapeutic intervention, there were no standardised ways as to conducting such professional practice.

Moreover, I realised that all the formally established perceptual voice assessment protocols were fairly limited in terms of the voice parameters that they took into consideration and the potential causal factors that they assessed (Soderpalm, 2006). A further finding that caught my eye was that perceptual voice assessment generally forms a significant part of voice assessment (Hunt and Slater, 2003). Therefore, perceptual voice assessment became one aspect of my research study, with specific emphasis being placed on whether singing should be included in such an assessment process.

A further finding was that research and professional practice have very much been consigned to the notion that speaking and singing behaviours are two completely different sets of behaviours (Welch, 2005). Therefore, speech and voice therapists usually only take speaking behaviour into consideration when assessing a child's voice since they have not necessarily been educated in including singing in their practice (Mathieson and Greene, 2003; Rubin et al., 2003). In addition, teachers educate children in viewing speaking and singing behaviours as separate entities despite the fact that the same voice is exploited as the main instrument for both behaviours.

On the basis of the research study, teachers, therapists and the general public can be educated on children's vocal functioning (i.e. voice quality, speaking and singing behaviours). The intention of the study is to: broaden the range of activities included in speech and voice therapy and in educational settings with children; bring about new awareness of children's speaking and singing behaviours; highlight the importance of healthy voice use within the child population; enhance speech and voice therapy practice with pre-pubertal children; and illustrate how music and singing can potentially have a positive effect on children's vocal functioning. All of the above issues are directly connected to my main areas of interest in research terms: the potential inclusion of singing in speech and voice therapy settings through the interconnected nature of the vocal behaviours and the holistic nature of children's vocal functioning.

1.2 Design of the thesis

On the basis of 'my research journey', the aim of the thesis is to investigate the phenomenon of the child voice. The main aim is to explore the potential use of singing in improving children's vocal functioning and voice quality in their speaking behaviour. From both personal and professional experience, I felt that it was important to investigate children's 'normal' and 'abnormal' vocal functioning and voice quality in the initial phase in order to subsequently be able to investigate how different factors influence the child voice (Carding et al., 2000; Hunt and Slater, 2003; Mathieson and Greene, 2003; White, 2001). Voice as a holistic entity (i.e. speaking and singing behaviours as connected to one another) is to be explored in the thesis (Thurman and Welch, 2000). In particular, voice quality in speech and singing are to be compared against each other and any connections between these behaviours are to be investigated. Different factors potentially influencing children's vocal functioning and potentially connecting children's speaking and singing behaviours are to be explored in more detail in order to investigate possible ways in which singing could be exploited in speech and voice disorder treatment in clinical and educational settings.

The study consisted of several phases. The first phase of the study consisted of carrying out an extensive literature review. Several aspects connected to the child voice were reviewed (see Chapters Two, Three and Four). The second phase was the pre-pilot study, in which ethnographic observation and interviews were carried out (see Chapter Five). The third phase of the study consisted of the pilot and the main empirical studies (see Chapters from Six to Nine). The fourth phase consisted of synthesising the empirical findings with the literature review (see Chapter Ten) and formulating implications for education and therapy (see Chapter Eleven).

In Chapter Two, the child voice is looked at in general terms, with specific reference to what is perceived as 'normal' and what is perceived as 'abnormal' in children's vocal functioning and voice quality (Bolfan-Stosic, 1998; White, 2001). Both speaking and singing behaviours are considered in order to highlight similarities and differences between the two vocal behaviours. The idea that the voice is the main tool for both behaviours is reviewed in order to highlight the potential connections between the two vocal behaviours. An overview of children's speech and voice disorders is provided, with particular emphasis being placed on hoarseness (McAllister, 1997 Sederholm, 1996). In summary, this chapter illustrates current knowledge of children's speech and voice disorders and children's overall vocal functioning.

In Chapter Three, the child voice is discussed as a holistic phenomenon. The idea that children's voices are holistic entities that are influenced by a number of factors is reviewed, with specific reference being given to potential causal factors for speech and voice disorders (Mathieson and Greene, 2003; Thurman and Welch, 2000). Potential connections between children's speaking and singing behaviours are explored, with an aim to demonstrate theoretically that singing activities should be included in children's speech and voice therapy settings. Furthermore, the intention is to demonstrate theoretically why speaking and singing behaviours should be regarded as interconnected rather than as two separate sets of behaviours. Theoretical evidence is gathered from physiological, neurological, developmental, holistic and therapeutic perspectives (Baker, 2002a; b; Brown et al., 2004; David, 1995; Silber, 2005; Thaut, 2000; Welch et al., 1996). Such theorising provides a grounding for the beneficial inclusion of singing in speech and voice therapy settings with children from a variety of perspectives.

In Chapter Four, different assessment methods for evaluating the child voice are reviewed and common diagnostic practices are discussed (Carding et al., 2000; Hirano, 1989; Kreiman and Gerratt, 2000). In particular, perceptual voice assessment and acoustical analysis are investigated with reference to their reliability and validity in clinical practice (Carding et al., op.cit.; Chan and Yiu, 2006; Kreiman and Gerratt, op.cit.; Sundberg, 2001). Emphasis is placed on perceptual assessment, since this is the most common method used in such practice (Yamaguchi et al., 2003). The discussion on assessing the child voice provides ground for formulating a new perceptual voice assessment protocol for the current study in addition to providing justification for the methods used in the study. The intention was to formulate the new protocol, which could then potentially subsequently be used as an instrument in professional practice.

In Chapter Five, the empirical part of the research study is outlined. The experimental design is explained and its use is justified. Ethical issues, participant selection and the choice of the data collection methods are clarified. Different parts of the data collection are described and the importance of each one is justified.

In Chapter Six, the findings from a physiological perspective are presented. In Chapter Seven, the findings from a developmental perspective are demonstrated. In Chapter Eight, the findings from a psychological perspective are illustrated. In Chapter Nine, the findings from a sociological perspective are presented. Chapter Ten includes the discussion section of the findings, tied in with the extended literature review. Finally, Chapter Eleven presents implications and suggestions for practice and for further research.

1.3 Research questions

Based on the extended literature review, the main research question for the study was formulated. This main question was:

1. Given the underlying physical structure for the human voice, what is the relationship (if any) between speaking and singing behaviours?

In addition, sub-research questions related to the main question were formulated. The questions are presented in the final paragraphs of Chapters 2-4. These research questions were:

1. What are the 'normal' and healthy characteristics of the child voice with reference to speaking behaviour?

2. What are the 'normal' and healthy characteristics of the child voice with reference to singing behaviours?

3. Do children's vocal functioning and voice quality vary in their dominant characteristics from between vocal behaviours?

4. Are children's overall voice quality and vocal functioning influenced by a variety of factors (such as those of physiological, psychological and sociological origins)?

5. Do the same factors influence children's speaking and singing behaviours?

6. Should singing be included in the perceptual assessment of the child voice?

7. Should various holistic factors be taken into consideration when assessing the child voice?

8. Is a perceptual voice assessment protocol that takes speaking and singing behaviours, as well as various holistic factors, into consideration a reliable and valid instrument in assessing the child voice?

Chapter 2: The child voice

2.1 Introduction

The purpose of this Chapter is to present current knowledge on children's vocal functioning and voice quality in regard to both their speaking and singing behaviours. Firstly, current knowledge on the child voice mechanism is presented. Secondly, the child voice mechanism and the physiological elements underlying children's voice production are described. Thirdly, various factors (i.e. those of physiological, psychological and sociological origins) that potentially influence children's voice quality and vocal functioning are discussed. This Chapter discusses the child voice as a holistic phenomenon rather than focusses on children's speaking and singing behaviours separately. A great amount of evidence is provided for children's speaking behaviour rather than their singing behaviour due to the fact that a greater amount of knowledge exists in reference to the former than in the latter vocal behaviour.

For the purpose of the study, it is essential to provide distinct definitions for speaking behaviour, singing behaviour and the voice. Speaking is defined as 'the act of producing words with appropriate intonation, volume and tone of voice when communicating with others in daily situations' (Bolfan-Stosic, 1998; Wilson, 1987). Singing is defined as 'the act of making musical sounds with one's voice in the form of a song or a tune' (Mang, 2001; Cross, 2002). Voice is defined as 'the audible sound that is the product of vibrating vocal folds and that is produced via the mouth when one is, for instance, speaking or singing' (Mathieson and Greene, 2003; Rubin et al., 2003).

2.2 'Normality' and 'abnormality' of the child voice

Children's voice disorders are a challenge to professional speech and voice therapists in regard to both diagnosis and treatment (Hunt and Slater, 2003; Mathieson and Greene, 2003; Wilson, 1987). In professional practice, it is essential to know what the elements of a 'normal' voice are in order to determine whether a child possesses a speech or a voice disorder (Andrews, 1991; Mathieson and Greene, op.cit.; Wilson, 1987). Nevertheless, it is difficult to determine what can be regarded 'normal' and 'abnormal' characteristics in the child voice since there is an enormous lack of normative data on children's vocal behaviours and their voice quality in any vocal functioning (Blumin, 2007; Hirano, 1989; Van der Wel, 2007; White, 2001). Therefore, there are no baseline reference points as to what can be regarded a 'normal' child voice. Moreover, there are no formally-established definitions for the voice parameters that the child voice consists of (Carding et al., 2000; Sederholm, 1996; Yamaguchi et al., 2003). Such lack of data indicates that professional possess their own concepts as to what are regarded as 'normal' characteristics and what as 'abnormal' ones in the child voice, with the perception of 'normality' and 'abnormality' of the child voice being subjective (Carding et al., 2000).

The process of defining 'normal' and healthy voice quality or 'abnormal' and unhealthy voice quality is complicated by the fact that children's voices are continuously influenced by a number of factors (such as those of physiological or psychological origin) (Andrews, 1991; Thurman and Welch, 2000). For example, a child's voice may sound different in the morning in comparison to the evening as the voice has been affected by the child's activities during the day, as well as by the child's environment (Hunt and Slater, 2003). In relation to this, each individual has a unique voice that has been shaped by his/ her life-experience (such as the sociolinguistic factors operating in the child's culture) and is continuously influenced by external and internal matter (such as pollutants and the child's emotional state) (Dolson, 1994; Kent and Ball, 2000; Mang, 2001). For instance, when a child is speaking in English, the child's voice may be perceived as sounding distinctively different from when (s)he is speaking in Chinese (Mang, op.cit.). Therefore, a wide range of voice qualities fall within the range of what can be regarded 'normal' voice quality (see Section 2.8 for a more detailed discussion on holistic factors). Such uniqueness of vocal functioning and voice quality further complicate professional speech and voice therapy practice.

'A normal voice' does not alert the attention of others, whilst 'an abnormal voice' does due to its tendency to range in quality (Kent and Ball, 2000). Lesley Mathieson (in Kent and Ball, p. 3) provided a comprehensive definition for 'a normal voice': 'a voice that is audible in a wide range of acoustic settings with even relatively high level of ambient noise whilst being appropriate for the individual's age, gender and fulfilling the speaker's paralinguistic and linguistic functions'. Moreover, the voice should not deteriorate with use and one should not feel any pain or discomfort during phonation (Kent and Ball, op.cit.). Clarity and audibility are regarded essential features of a 'normal' voice (Andrews, 1991; Carding et al., 2000; Hirano, 1989; McAllister, 1997; Sederholm, 1996). In addition, a phonologically 'good' voice should have a well-defined balance of oral and nasal resonances (Speciale and Cimino, 1997). It should be noted that both perceptual and acoustic voice analyses has been used when gathering data on the 'normality' and 'abnormality' of the child voice. The majority of such studies (Hirano, op.cit.; Kent and Ball, 2000; McAllister, op.cit.; Sederholm, op.cit.) have relied on both perceptual and acoustic voice analyses. The remaining studies (Andrews, 1991; Carding et al., op.cit.; Kent and Ball, op.cit.; Speciale and Cimino, op.cit.) have primarily focussed on either type of assessment. Such differences in analyses approaches complicate the process of drawing generalisations across the studies.

A voice disorder may appear through an imbalance between these two types of resonances by, for example, causing the voice to be breathier than usual or being perceived as exhibiting whisper-like sounds (Rubin et al., 2003) or being associated with other undesirable voice qualities (such as excessive nasality) (Sederholm, 1996). Nevertheless, there are no defined concepts as to what can be perceived as 'normal' and healthy in the child voice.

A subset of researchers has formulated definitions for a 'normal' child voice for the purpose of their own studies or as results from the empirical findings of their studies (sees Table 2.1). For example, Wilson (1987, p. 2) defined a 'normal' child voice as 'possessing a pleasing quality, correct balance of oral and nasal resonance, appropriate loudness and fundamental frequency for the gender and the age of the child in question' (see Table 2.1). A 'disordered child voice' would, consequently, not fulfil the outlined criteria. It should be noted, however, that the above definition implies that 'normal' voice quality varies between children of different ages. A question, then, arises as to what is 'normal' voice quality for a child of a given age and gender (such as a 8-year-old girl or an 11-year-old boy). A substantial database for children belonging to different age-groups could provide tentative definitions for 'the normal' characteristics and 'the abnormal' characteristics of the child voice. Furthermore, the studies on the 'normality' of the child voice have primarily either relied on perceptual voice data (Wilson, 1987) or acoustic voice data (White, 2001), with only a few of them exploiting both types on assessment (McAllister, 1997; Sederholm, 1996). A comprehensive study gathering data for such 'normal' characteristics would, ideally, exploit both types of assessment and analyses for reliable and valid data.

Author	Age of Children	Number of Children in the Study	Most Common 'Abnormal Characteristics'	Prevalence	Average Voice of a Ten-year-old
Sederholm, E. (1996)	10 years	268 (Female= 129; Male= 139) (non-singers)	Hoarseness= A quality of voice that is rough, grating, harsh, more or less discordant, and lower in pitch than normal for the individual (reflects breathiness, hyperfunction and roughness)	14 % in first study (chronic 6 %); 24 % in second study (chronic 14 %)	Certain degree of breathiness, hyperfunction, voice gratings, vocal fry and hard glottal attacks When the child is speaking
McAllister, A. (1997)	8.5-11.5 years	63 (Female= 25; Male= 38) (non-singers)	Hoarseness, breathiness, hyperfunction, roughness, unstable pitch/ quality, voice breaks	24 % hoarse (chronic 14 %)	Certain degrees of hyperfunction, breathiness and vocal fry; 24 semitones of pitch-range; restricted dynamic range When the child is speaking
White, P. (2001)	11 years	In first study, 44 (Female= 26; Male= 18); In second study, 29 (Female= 15, Male= 14) (singers)			Free of breathiness; higher formant frequencies for girls than for boys; higher formant frequencies in speaking than in singing When the child is a trained singer

Table 2.1: Normative child voice data

An innovative study has been conducted by Welch and his colleagues (2001) who have been exploring potential definitions for the 'normal' characteristics of the child voice and the development of such characteristics alongside children's physiological maturing process. The specific emphasis has been on children's speaking behaviour, with an attempt to divide the vocal characteristics into 'normal' and 'dysfunctional' characteristics (Welch et al., op.cit.). Children's singing behaviour has also been explored in the study with regard to separating 'normal' and 'supranormal' voice characteristics when looking at children aged from three to fifteen years. The study gathers voice data via speaking and singing tasks, with such voice data subsequently being evaluated both perceptually and acoustically.

Yet, the process of finding such definitions has proved challenging due to the fact that a considerable amount of voice data are needed in order to draw any generalisation. Therefore, there is still a lack of knowledge on the 'normality' and 'abnormality' children's vocal functioning and voice quality. Both speaking and singing behaviours need to be looked at in order to gather data for both highlight any differences and similarities between these two vocal behaviours. None of the conducted studies have considered both vocal behaviours, but have focused on children's speaking behaviour. Furthermore, definitions for particular voice parameters have not been formulated. For example, there is no concrete definition for hoarseness. Such claims suggest that it may be difficult for a professional to diagnose and to define a speech or a voice disorder.

2.3 Prevalence of speech and voice disorders

In professional speech and voice therapy terms, 'abnormal' voice quality and vocal functioning are referred to as speech and voice disorders (Rubin et al., 2003). A significant number of pre-pubertal children possess a speech or voice disorder (Carding et al., 2006; McAllister, 1997; Sederholm, 1996). The prevalence of such disorders has been reported to have been increasing in recent years (Cheng, 2006; Hunt and Slater, 2003). For the past decade, the prevalence was approximately 14-17 percent in the population of 10-year-olds (Carding et al., op.cit.; McAlliser, op.cit.), whereas in the 1960s, it was only 6 percent (Wilson, 1987). Nevertheless, the highest prevalence of voice distortions has been recorded in children between six and nine years of age (Sederholm, op.cit.). Nevertheless, a limited amount of research has been conducted in the field of such disorders and, therefore, the true prevalence of such distortions may be even higher than what is currently known (Sederholm et al., 1993).

Although it may be difficult to draw a line between a speech disorder and a voice disorder, the incidence of voice disorders is lower than the incidence of speech disorders (Hunt and Slater, 2003; Law and Miller, 2000; McAllister, 1997). The explanation for this may be that children often develop distorted voice quality later on in their life, as a result of voice abuse over a longer period of time (Hunt and Slater, op.cit.; Bolfan-Stosic et al., 2003; Mathieson and Greene, 2003). An alternative explanation would be that children's physiological voice mechanism changes as children mature and approach puberty (Stathopoulus, 1998; Welch, 2001b), with such physiological changes shaping children's vocal products and potentially resulting in voice distortions (Welch and Howard, 2002). Poor vocal habits learned at early stages in life may result in more severe voice distortions and may be carried on to adulthood (Decoster, 2007; Virokannas, 1997). Such findings imply that it would be important to treat children's voice disorders as early on in life as possible. Earlier diagnosis and intervention would prevent major distortions from manifesting themselves.

Moreover, since childhood is considered a crucial period in children's lives in regard to forming a concrete psychological foundation for subsequent development, the ignorance of a speech or a voice disorder may have significant influence on children's sense of self-identity and psychological well-being (Baker, 2002a; b; Bolfan-Stosic et al., 2003; Pellowski and Conture, 2002; Salameh, 2006; Sederholm, 1996; Sell, 2005; White, 2001). Moreover, vocal communication is the main form of communication amongst humans and healthy vocal functioning is an essential tool in making oneself understood to others (Nienkerke-Springer et al., 2003), playing further importance on efficient vocal functioning. Extreme forms of any of these disorders are, nevertheless, rare amongst children (Butler and Cheng, 1998).

2.4 Speech, voice and singing disorders in children

Although both speech and voice disorders concern children's vocal product, a greater deal is known about the nature of speech disorders than the nature of voice disorders (Bolfan-Stosic et al., 2003; Hunt and Slater, 2003; Nienkerke-Springer et al., 2003; Sederholm, 1996). A variable minority of children also suffer from a form of a singing disorder, the nature of which is also difficult to define (Welch and Howard, 2002).

2.4.1 Definitions for speech and voice disorders

A wide range of definitions exists for speech and voice disorders, further complicating the process of determining the true prevalence of such disorders (Martin and Miller, 2003). Furthermore, it may be difficult to draw a line between speech order and disorder, or between different forms of speech disorders since the disorders often overlap (Eisenson and Ogilvie, 1977; Hunt and Slater, 2003).

Traditionally, speech disorders have been divided into: a) language disorders (i.e. deviations in the structure or the function of language) and b) articulation disorders (i.e. the omission or distortion of speech sounds and any disturbances in the rhythm of speech) (Bloodstein, 1975; Byrne and Shervian, 1977; Eisenson and Ogilvie, 1977). Articulation or disfluency disorders (also known as stuttering or stammering) are the most common forms of speech disorders (Schwalkwijk, 2000). The main characteristic of such disorders is the act of hesitating when speaking or stumbling of words when speaking (Beech and Fransella, 1968; Martin and Miller, 2003). No exact and fully-adequate definitions have been formulated for stuttering, and there is no satisfactory theory explaining its origins (Martin and Miller, op.cit.). The exact original causal factors for such a speech disorder are not known, although psychological factors have been claimed to play a major role (Schwalkwijk, op.cit.).

Voice disorders deal with vocal functioning and voice quality with reference to any vocal behaviour (Bolfan-Stosic, 1998; Bolfan-Stosic and Prinztl, 1998; Rubin et al., 2003). Disordered voice quality has its origin in the abnormal functioning of the vocal tract (Rubin et al., op.cit.). Such malfunctioning itself may have diverse origins (such as a physiological or a psychological nature) (Hunt and Slater, 2003) (see Section 2.9.2). In regard to this, Sundberg (1987) claimed that the majority of voice disorders deal with the phonatory aspects of voice production rather than with the articulatory aspects exploited in voice production. Since voice disorders deal with voice in general terms, they are closely connected to speech and singing disorders.

A voice disorder can manifest itself as a distortion in any voice parameters (such as the timbre of the child's voice or the pitch of the child's voice) or as a disturbance in the intensity of a child's voice (Hunt and Slater, 2003; McAllister, 1997). A variety of 'abnormal' voice qualities are often interdependent (Hunt and Slater, op.cit.), with rarely only one parameter of a child's voice being perceived as 'abnormal', whilst the others remain 'normal'. Pitch range, habitual pitch and resonance of a child's voice are most commonly distorted when a child is diagnosed as possessing a voice disorder (Mathieson and Greene, 2003). 'Abnormality' is evident in the child's fundamental vocal output in the sense that distortions are perceived in one or more of the parameters in the child voice (Sundberg, 1996). An example of a voice disorder would be an excessively breathy voice quality when the child's age, gender and other background characteristics are taken into account (Andrews, 1991).

2.4.2 Definitions for singing disorders

There are no formally-established definitions and classifications for singing disorders since such distortions have not been regarded as equally importance to speech disorders due to their lower prevalence (Rubin et al., 2003). When a child possesses a singing disorder, the child is not able to sing at all or there are disturbances (such as repetitions) in the sung passages (Bunch, 1997). Such distortions are, at times, results of speech disorders (Rubin et al., op.cit.). An example of a singing disorder would be an individual who experiences difficulties in sustaining a specific pitch when producing a melodic sound with a desirable volume (Bunch, op.cit.). According to Brand (2000), errors in the children's singing behaviour derive from common patterns found in the individuals' musical organisations that have developed on the basis of the children's comprehension of auditory stimuli. When the individuals' intuitive organisation of auditory stimuli has not been developed fully or according to the 'normal' pattern, distortions may occur in the individuals' voice production during singing (Brand, op.cit.).

At times, speech and singing disorders are connected. For example, an individual's singing ability may be disordered due to the individual's inefficient speaking skills (Welch, 2001b). Another example would be monotonous speech, potentially leading a child to sing out of tune (Welch, 1985). Very few children possess a singing disorder (Bunch, 1997). A limited amount of research has been conducted in the field of singing disorders and, thus, a greater number of children than what is known may possess such distortions (Rubin et al., 2003). It should be noted that it is also possible for a child to possess an extreme form of speech distortion, whilst possessing no apparent distortions in his/ her singing behaviour (Potter, 2001; Rubin, 2005). Furthermore, singing distortions are closely linked to voice disorders since all of such disorders deal with the quality of the individual's voice (Bunch, op.cit.; David, 1995).

2.5 'Abnormality' in different voice parameters

Specific voice parameters (such as hoarseness) tend to become distorted more easily than other voice parameters (such as hypofunctional voice qualities) in the child voice (Bolfan-Stosic et al., 2003; McAllister, 1997; Sederholm, 1996). 'Abnormality' in the separate voice parameter contributes to an impression of 'abnormal' characteristics in vocal functioning or voice quality potentially in any vocal behaviour (Carding et al., 2000; Mathieson and Greene, 2003). Such definitions have primarily been based on perceptual voice assessment (Carding et al., op.cit.; Mathieson and Greene, op.cit.; McAllister, op.cit.; Sederholm, op.ci.t), with their acoustic correlates remaining ambiguous. However, since there are no formally-established definitions for independent voice parameters (such as roughness), the diagnosis of 'abnormality' in any of the parameters is a challenging process. In addition, professionals may rely on different definitions in their work, indicating that there may be a wide variety of such definitions may exist, indicating that it may be difficult for professionals to talk about their assessment outcomes.

The most common voice distortions in the child voice are: hoarseness (i.e. harsh voice quality); harshness or roughness (i.e. unpleasantly rough voice quality); and excess nasality (i.e. voice is produced with an excessive use of nasal cavities) (Bolfan-Stosic, 1998; McAllister, 1997) (see Table 2.2 below). Abnormal variations in pitch can also be recorded relatively frequently (Bunch, 1997). Such variations may be extremely distracting due to the fact that intonations heard in the vocal product are, in fact, pitch inflections that make speech and singing expressive (McAllister, op.cit.). An example of such a disorder would be a restricted pitch-range, resulting in speech that is perceived as monotonous (Bunch, op.cit.).

TABLE SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

Table 2.2: Most common 'abnormal' and unhealthy vocal characteristics in pre-pubertal children's vocal functioning and voice quality in their speaking and singing behaviours (adapted from Wilson, 1987)

2.6 Connections between speech and voice disorders

Although a child may possess a speech or a voice disorder without exhibiting any other vocal distortion, a subset of children possesses both a speech and a voice disorder (Rubin et al., 2003). Moreover, speech, voice and singing disorders may manifest themselves as a network of distortions influencing one another (David, 1995). On the basis of such claims, it may be crucial to recruit a speech therapist for treating voice disorders, or to adopt an inter-disciplinary professional treatment team for providing a child with successful intervention (Butcher et al., 1987; Hunt and Slater, 2003; Whiteside and Hodgson, 1999).

Causal and contributing factors for speech, voice or singing disorders may be of the same origin (such as physiological nature) (see Chapter Three). Therefore, speech and voice disorders can be divided into broad categories according to their underlying causal factors (Mathieson and Greene, 2003) (see Section 2.8). Such underlying connections provide further evidence for connections between all the distortions.

2.7 Implications for the current study

As it has been demonstrated above, there is a considerable lack of knowledge in the field of children's vocal behaviours and their voice quality in regard to their speaking and singing behaviours. In particular, ambiguities remain as to what can be regarded as 'normal' and healthy or as 'abnormal' and unhealthy characteristics in the children's vocal functioning and voice quality in terms of both their speaking and singing behaviours. On the basis of the above discussion, the following research questions were formulated:

- What are the 'normal' and healthy voice characteristics of the child voice with reference to children's speaking behaviour?

- What are the 'normal' and healthy characteristics of the child voice with reference to children's singing behaviour?

- Do children's vocal functioning and voice quality change according to their vocal behaviour?

2.8 The child voice as a holistic entity

The child voice is simultaneously influenced by a number of factors (such as physiological and sociological factors) (French, 2006; Hofmann, 2006; Thurman and Welch, 2000). Such factors shape children's vocal functioning and voice quality. Therefore, a number of factors contribute to 'the normal' and 'the abnormal' characteristics of the child voice (Hunt and Slater, 2003; Mathieson and Greene, 2003; McAllister, 1997; Rinta and Welch, 2006; Sederholm, 1996; Welch, 2005). Such claims indicate that several factors may be the origins of speech, voice and singing disorders. A distorted voice may have its origin in a specific causal factor (such as irregular breathing patterns) or in several diverse factors (such as anxiety and social isolation) (Baker, 2002a; b; Hunt and Slater, op.cit.; Mathieson and Greene, op.cit.; Rubin et al., 2003).

Various factors pre-dispose vulnerable children to speech or voice disorders within such a complex network (Virokannas, 1997). The categories for such pre-disposing causal and contributing factors overlap in the form of a complex network (Hunt and Slater, 2003; Nienkerke-Springer, 2003). For instance, the primary causal factor underlying a speech or voice distortion may be of psychological origin, subsequently leading to social isolation, with the combination of these two factors maintaining the disorder (Baker, 2002a; b; Bouwers and Dikkers, 2007). The causal and contributing factors can be divided into three broad categories: those of physiological nature, those of psychological nature and those of sociological nature (Sederholm, 1996).

2.9 Physiological causal and contributing factors

From the physiological perspective, children's vocal functioning and voice quality are influenced by their genetics, general health and pathological elements in the body (Bunch, 1997; Welch and Murao, 1994). When the underlying casual factor is regarded as being of physiological nature, a malfunctional physiological element or elements in the individual's organism are causing his/ her vocal output to be 'abnormal' and to sound unhealthy (Colton and Casper, 1996; Mathieson and Greene, 2003; McAllister, 1997) (see Figure 2.1).

Acoustic differences recorded between voice data gathered from children and those gathered from adults derive from the distinct physiological and aerodynamic conditions between these two populations (Hunt and Slater, 2003; Stathopolous and Weisner, 1985). Weinrich with his colleagues (2005) highlighted the differences between a 'normal' adult voice and a 'normal' child voice. Their main finding was that the child voice is more similar to the female adult voice than to the male adult voice. For example, the subglottal threshold pressure in children is relatively similar to that recorded in female adults (McAllister, 1997). On the basis of such findings, a disordered child voice should be compared to 'a normal child voice' rather than to a 'normal' adult voice in order to conduct a reliable assessment, as well as effective intervention (Weinrich et al., op.cit.).

2.9.1 Child voice mechanism

Firstly, prior to eliminating potential physiological causal and contributing factors behind children's speech and voiced disorders, the child voice mechanism needs to be described. The most significant differences between the adult and the child voice mechanisms are highlighted here in order to demonstrate possible physiological causal factors behind children's speech and voice disorders (Corbin-Lewis and Johnson, 2000; Freeman, 2000; Keilmann, 2007).

The main differences between the child and the adult voice mechanisms derive from children's anatomical immaturity (Welch and Howard, 2002). Most significant differences are recorded in: vocal tract size; formant frequencies; the structures of the larynx; the structure of the vocal folds; and glottal closure (i.e. incomplete in children but complete in adults) (Sederholm, 1996).

More specifically, the position of the larynx is higher in children than in adults (Hunt and Slater, 2003; Mathieson and Greene, 2003; Sapienza and Hoffman, 2001). Its shape is also more rounded in the former population than in the latter (Hunt and Slater, op.cit.). The larynx descends throughout childhood with rapid changes taking place in the laryngeal structures during the first three years of life (Whiteside and Hodgon, 1999). The shape of the larynx becomes comparable to that of adults at approximately nine years of age (Hunt and Slater, 2003). The overall size is smaller in children, with the ratio of the membrane and the cartilage in the folds greatly differing between children and adults (i.e. the membrane is smaller in the developing child voice mechanism than in the mature adult voice mechanism) (Stathopoulus, 1998; Welch and Howard, 2002).

Children's cartilages are more plastic and less rigid in texture than in those of adults, and children's vocal tissue is less developed than that of adults (Hunt and Slater, 2003; Welch and Howard, 2002.; Whiteside and Hodgson, 1999). Children's and adult's cartilages also differ in texture, with the fibres being less rigid and more plastic in children than in adults (Stathopoulos, 1998). The fibres of the vocal fòld tissue are also less developed in the child population (Welch and Howard, 2002). Furthermore, in adults, the cover of the folds is differentiated into three layers, whilst in children, such differentiation cannot be observed before the age of 16 (Sederholm and McAllister, 1997; Welch and Howard, op.cit.). The vocal tract located above the larynx is also less developed in children than in adults, resulting in restricted resonance in children (Sederholm and McAllister, op.cit.).

Furthermore, the prime muscles employed in vocalisation differ between children and adults (Hunt and Slater, 2003; Thurman and Klitze, 2000; Welch and Howard, 2002). The cricothyroid muscle is the biggest and the most important element in children's vocalisation, whilst a variety of muscles are of prime importance in adult vocalisation (Hunt and Slater, op.cit.). Furthermore, children are not born with a vocal ligament, with one only developing at the age of four and continuing to develop until the age of twenty (Thurman and Klitze, op.cit.). The inner structures of the vocal folds also differ between children and adults, with mucosa being thinner in children than in adults, with the amount of mucus being greater in comparison to the membranous length in children (Welch and Howard, op.cit.). Vocal folds are also shorter in children than in adults, due to which the pitch of the child voice is higher than that of the adult voice (Welch and Howard, 2002). In addition, overall amplitude of the vocal fold vibration is smaller in children than in adults (Sederholm, 1996), with the child voice being less complex in its acoustic characteristics in comparison to adult voice (Welch and Howard, op.cit.).

Additionally, the glottis and the epiglottis differ between children and adults (Schneider and Bigenzahn, 2003). In adults, the glottis is the narrowest point in the mechanism (Rubin et al., 2003). The child voice mechanism has not yet developed to resemble the adult voice mechanism in this sense (Mathieson and Greene, 2003) (see Figure 2.1). Finally, the function of the lower respiratory muscles is slightly different between child and adult populations (White, 2001). For instance, the diaphragm is the main respiratory muscle in children's voice production, whilst both the diaphragm and the intercostal muscles supporting the lungs are the main tool in adults' voice production (Hunt and Slater, 2003). It should be noted that lung functioning is almost identical in boys and in girls during childhood, but significant differences between the sexes arise once children enter puberty due to the fact that children's control of respiration gradually develops as they grow and mature, with their ability to speak and sing developing alongside their respiratory functioning (Hunt and Slater, op.cit.; Mathieson and Greene, op.cit.). For example, the volume of the airflow increases as the child grows and his/ her larynx grows larger, which subsequently makes speaking and singing easier for the child (Bybee and Ford, 2003).

DIAGRAM SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

Figure 2.1: The voice mechanism – the picture illustrates the different elements of the voice mechanism that underlie all vocal production (the figure is adapted from (adapted from www.voiceproblem.org/ anatomy)

2.9.2 Malfunctioning of the voice mechanism

The characteristics of any speech or voice disorder depend on the underlying physiological element, which is not functioning properly (Rubin et al., 2003; White, 2001). 'Abnormal' functioning of such structures may result in more severe speech or voice distortions (Rubin et al., op.cit.). For instance, articulatory structures are essential in generating all vocal products, with 'abnormality' in the functioning of such structures greatly influencing the final vocal product (Bybee and Ford, 2003; Sundberg, 1996).

When the voice mechanism is exploited correctly, throat and the neck muscles that are not a necessity for voice production are released and the needed muscles are employed with a sufficient amount of contraction energy (Thurman, 2000). Inefficient functioning or exploitation of any physiological elements in the voice mechanism or in other parts of the body significantly influences children's vocal products (Hunt and Slater, 2003). A habitually poor body posture is a common causal factor for speech and voice distortions (Bunch, 1997; Rubin et al., 2007; Story et al., 2001). Muscular tension is also often found in children's neck and shoulder areas, as well as in their facial muscles, when the child possesses a voice disorder (Andrews, 2001). Tension in the head and the neck muscles, in particular, may cause the joints in the facial or neck area to become irritated, resulting in distorted voice quality (Hogikyan et al., 2000).

Identifying tension in the child's extrinsic muscles provides insight into the posture of his/ her intrinsic muscles, potentially being of help in order for one to conduct a correct diagnosis for the original causal factors underlying a vocal distortion and, subsequently, in formulating effective intervention strategy (Angsuwarangsee and Morrison, 2001). Once all physiological tension has been released in professional practice, the quality of the child's voice inevitably improves (Titze, 2004; Rubin et al., 2003). It should be noted that tension present in the body may not be of physiological nature; rather it may originate from a psychological or sociological factor (Hunt and Slater, 2003; Mathieson and Greene, 2003). Such a claim indicates that, with such individuals, the psychological aspects behind the tension need to be treated in order for the child's vocal output to improve (Butcher et al., 1987).

Voice abuse occurs when the voice is produced with the use of the unnecessary muscles, or when the necessary and regular muscles are working harder than necessary, subsequently resulting in vocal fatigue (Bunch, 1997; Rubin, 2005). When voice abuse continues to take place on a longitudinal basis, the tissues in the voice mechanism often becomes irritate, inflammated and further influences the overall quality of the child's voice (Mathieson and Greene, 2003). Since vocal folds collide with each other at approximately the speed of three million collisions per day, inefficient voice production is likely to cause a child's voice to become distorted (Bastian et al., 2002). The vocal folds may become damaged due to the abuse caused by too great an amount of force or with too limited amount of force that may subsequently cause the mucosa cover of the folds to tear and result in 'abnormal' voice quality (Arnold, 1962; Rubin et al., 2003; Rubin, op.cit.). Swelling is the most common reaction to external matter, which significantly influences the functioning of a child's voice mechanism (Rubin et al., 2003). An example would be oedema that is particular type of swelling and is defined as the general swelling of the vocal folds (Mathieson and Greene, op.cit.). Polyps are another example; they are also results of swelling in the form of blisters on the vocal folds, being caused by inefficient use of the voice mechanism (Bybee and Ford, 2003).

There are more specific physiological conditions arising from vocal abuse (Rubin et al., 2003). For instance, distorted respiration is connected to inefficient exploitation of the voice mechanism and may also be the original causal factor for a speech or a voice disorder (Bybee and Ford, 2003). More specifically, habituated inefficient breathing patterns may lead to the adaptation of inefficient voice production techniques (Hunt and Slater, 2003). Abnormalities in the vocal tract are also common since the tract contains three components of the immune system (i.e. adenoids, palatine tonsils and lingual tonsils) that are susceptible to external irritants (Hogikyan et al., 2000). For instance, a structural abnormality in the vocal tract inevitably influence an individual's vocal functioning and final vocal product (Mathieson and Greene, op.cit.; Rubin et al., 2003).

Severe dysphonia is often a result of poor respiration (Gordon, 1996). Furthermore, compensatory functions as results of alterations in children's vocal tract areas often manifest from medical conditions (such as upper respiratory infections) and often further result in distorted vocal functioning or voice quality (Bunch, 1997; Gordon, op.cit.; Hunt and Slater, op.cit.). Such compensatory functions are usually habituated over time and they need to be corrected in therapy (Rubin et al., 2003). Furthermore, habitually inefficient voice production techniques may further influence the functioning of a child's muscular and skeletal systems, subsequently resulting in distorted voice quality (Bunch, op.cit.).

Physiological malfunctioning of any elements in a child's voice mechanism may have significant effects on the child's voice quality, as well as on the child's speaking and singing behaviours (Angsuwarangsee and Morrison, 2001; Mathieson and Greene, 2003; Titze, 1994). An example of inefficient voice production would be hoarseness (Bunch, 1997; McAllister and Sederholm, 1997), whilst breathiness is connected to poor respiratory functioning (Bunch, op.cit.). Other examples are structural abnormalities in nasal structures that, subsequently, result in hyponasality (Rubin et al., 2003) and 'abnormal' functioning of the trancea influences the airflow needed for phonation (Titze, op.cit.). With children, excess nasality associated with the inflammation of nasal mucosa is commonly reported (Mathieson and Greene, op.cit.). Such a distortion often leads to hoarseness (Sederholm, 1996). However, it should be noted that when two children possess the same physiological abnormality, the overall quality of the children's voices may still be perceived to possess distinct vocal sound (Angsuwarangsee and Morrison, op.cit.). Likewise, when the voice qualities of two children are perceived to be similar, the causal factors behind such qualities may not be of the same origins or nature (Niimi and Miyaji, 2000).

Studies investigating physiological mechanisms underlying vocal behaviours require a comprehensive medical examination (Rubin et al., 2003). Such an examination relies on specific equipment and expertise knowledge, indicating that a cross-disciplinary team (such as consisting of a doctor and a speech therapist) may be needed in such an investigation. The studies mentioned above (Angsuwarangsee and Morrison, 2001; Bunch, 1997; Mathieson and Greene, 2003; Niimi and Miyaji, 2000; Rubin et al., 2003; Titze, 1994) present data that have been gathered by such a cross-disciplinary team.

In addition, a number of genetic syndromes are associated with speech and voice disorders, with the sufferers of such syndromes possessing genetic predispositions for speech or voice disorders (McAllister, 1997; Sederholm, 1996; Van Borsel, 2004). For instance, Rutter with his colleagues (1990) found evidence of genetic causal factors concerning the management of voice production. Nevertheless, a genetic predisposition is not enough on its own in causing a vocal distortion to manifest itself and so additional factor(s) are needed in order for the disorders to be established (Rubin et al., 2003; Sederholm and McAllister, 1997).

2.9.3 Vocal functioning and other physiological systems

The human body is a complex system that consists of the nervous, endocrine and immune systems (Hunt and Slater, 2003; Mathieson and Greene, 2003; Thurman and Welch, 2000). Each system is closely connected to our psychological side and influenced by a number of external factors (Baker, 2002a; b; Colton and Casper, 1996; Hunt and Slater, op.cit.; Mathieson and Greene, op.cit.; Thurman, 2000). Auditory stimuli greatly influence us through the neural networks that connect the above systems to one another (Welch, 2005).

The processes of voice production requires the nervous system (i.e. the brain and neural networks), while immune and endocrine systems operate in a close relationship with children's psychological side through both being affected by it and influencing it (Papousek, 1996; Thurman, 2000; Weber-Fox, 2001; Welch, 2005). Any disturbances in the function of any of the above systems may result in a speech or a voice distortion.

2.9.4 The nervous system and the brain

The nervous system and its neural networks are needed for the generation of all human functions (including speaking and singing) (Peretz and Coltheart, 2003; Zatorre et al., 2002). The nervous system is divided into; the central nervous system (i.e. the brain and the spinal cord) and the peripheral nervous system (i.e. the network that connects sensory receptors to the central nervous system and links the central system to muscles and glands) (Thurman, 2000). Disturbances in neural processes in any of the systems may result in speech or voice distortions (Peretz and Coltheart, op.cit.; Zatoore et al., op.cit.).

More specifically, the brain plays a part in all vocalisation due to the fact that each brain area is responsible for processing different types of auditory information (Fisher, 2007; Peretz et al., 2000; Perry et al., 1999; Zatorre, 2007; Zetterholm, 2002) (see Figure 2.2). The left hemisphere of the brain is primarily responsible for the processing of language and speech, whilst the right hemisphere is primarily responsible for the processing music (Peretz and Coltheart, 2003; Zatorre, op.cit.; Zatorre et al., 2002). Thus, damage to the left hemisphere usually results in speech and languages disorders, whilst damage to the right hemisphere results in distortions in musical elements (Perry et al., op.cit.). Voice disorders may, subsequently, be caused by inter-hemispheric damage or by unique damage to either hemisphere (Peretz and Coltheart, op.cit.). Nevertheless, overlap has been recorded between the functions of the two hemispheres (Peretz and Coltheart, 2003; Zatorre et al., op.cit.).

When a person suffers from a speech or a voice disorder, the individual's hemispheres may not have developed according to the usual developmental patterns (Fisher, 2007; Horsley and FitzGibbon, 1987). Most often, there is either a lack of dominance or considerable weakness in the individual's left hemisphere (Weber-Fox, 2001). Brain scans have revealed that a greater amount of alpha rhythms appear in the right hemisphere of the brain in the individuals who suffer from speech disorders (in particular stutterers) when they speak (Fletcher and Hall, 1992) (see Figure 2.2). Kracke (1975) stated that children with speech difficulties may also possess difficulties with rhythm perception due to the fact that there appears to be a significant relationship between children's verbal and non-verbal communication abilities and that children usually exploit symbolic tools for both types of communication (Fletcher and Hall, op.cit.), suggesting that there are neurological connections between the processing of speech and the processing of singing.

Furthermore, various types of speech and voice disorders may occur as results of brain damage, depending on the brain area(s) that has been affected by the damage (Angsuwarangsee and Morrison, 2001; Fisher, 2007). Furthermore, Tallal (1985) argued that a number of cognitive difficulties are associated with speech disorders. Such arguments provide indication for potential cognitive functioning underlying speech and voice disorders.

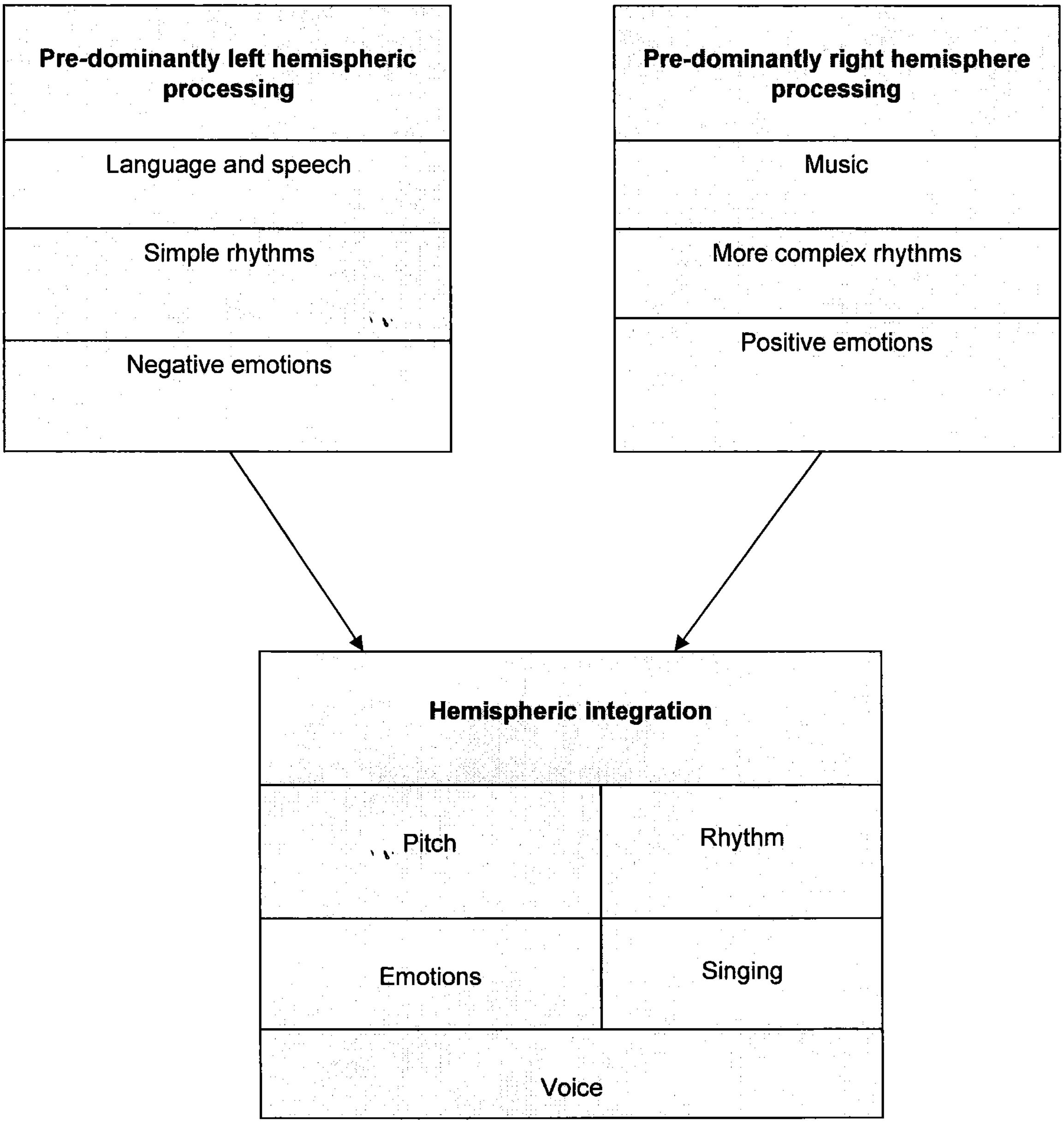


Figure 2.2: Model on the auditory stimuli that the left and right hemispheres pre-dominantly process and the stimuli that rely on inter-hemispheric processing

2.9. 5 Nervous system and neural networks

Disorders concerning the nervous system may be divided into three separate categories: somatosensory disorders, cognitive disorders and motor disorders (Hogikyan et al., 2000). In regard to the first category, the main element is laryngeal nerves that are also the most important sensory nerves in voice production (Bybee and Ford, 2003; Sundberg, 1996). These nerves constitute an essential element of the voice mechanism. In regard to the second category, the brain is the main element (see Section 2.9.4 above). Brain damage, or cognitive disabilities, can be the original causal factors for speech and voice disorders (Horsley and FitzGibbon, 1987) .With reference to the third category, motor control is essential for efficient vocal functioning and, when managed poorly, may deteriorate vocal functioning (Thurman et al., 2001).

A child's nervous system changes and refines itself whilst the child grows, with the child simultaneously gaining control over his/ her voice mechanism (Fox et al., 2002). Disorders that deal with the nervous system may deteriorate the child's vocal functioning (Whiteside and Hodgson, 1999). Specific developmental disabilities influence the control and the co-ordination of the muscles receiving commands from both hemispheres of the brain (Byrne and Shervian, 1977). Such control is usually weaker in speech disorder sufferers than their 'normally'-developed peers, further being reflected in the children's vocal functioning and voice quality (Fox et al., op.cit.).

2.9.6 Immune system

The nervous system is connected to the immune system through neural networks (Thurman, 2001). The function of the immune system is to protect us against external matter (such as viruses and pollutants) (Thurman, op.cit.) via reacting to any invaders in the form of an acute or chronic inflammation (Rubin et al., 2003). Infections and inflammation (if not prevented by the immune system) in any part of the body may influence the quality of a child's voice (Thurman, 2001; Vertigan et al., 2007). For example, infections in the respiratory tract often affect an individual's voice quality negatively (Rubin et al., op.cit.).

A child's respiratory and digestive systems may also be affected by non-infectious disease since such systems are constantly exposed to external matter (Hogikyan et al., 2000). For example, excess acids in the digestive system may alter the functioning of the abdominal muscles, subsequently influencing an individual's voice production (Titze, 1994). In addition, allergies have been reported to be a causal factor for voice distortions (Rubin et al., 2003; Speciale and Cimino, 2000; Thurman, 2001).

2.9.7 Endocrine system

The endocrine system forms a part of the complex physiology that influences our vocal functioning (Thurman and Welch, 2000). The main components of the endocrine system are hormones (Rubin et al., 2003). Fluctuations in hormonal levels are relatively common amongst children whilst growing up (Welch and Howard, 2002).

Fluctuations can be interpreted by the body and the mind in various ways (Baker, 2002a; Thurman et al., 2000). Examples of alternative interpretations are: physiological illnesses, psychological stress, reduced cognitive functioning, or a structural physiological abnormality (Thurman et al., op.cit.) (see Section 2.11 below for psychological factors). Such disturbances may further influence several natural physiological processes and patterns (such as the sleep-wake cycle), subsequently influencing the children's vocal functioning and vocal products (Baker, op.cit.). Thyroid disorders and diabetes are examples of this type of disturbances (Thurman et al., 2000).

2.9.8 The hearing mechanism

The hearing mechanism plays a crucial role in correcting and modifying children's vocal product through auditory perception (Brestovci and Bolfan-Stosic, 1998; Bunch, 1997; Davis, 2007; Fourcin, 2005; Thurman and Gramsch, 2000). Distorted perception and poor memory for vocal tone quality, language sounds or musical elements may result in distorted speaking and singing abilities (Thurman and Gramsch, op.cit.). In particular, hearing impairment may have a significant effect on articulation and intonation (Brestovci and Bolfan-Stosic, op.cit.; Van Lierde et al., 2004).

There are several types of hearing loss (Hogikyan et al., 2000). The most common ones are conductive hearing loss and sensorineural hearing loss (Hogikyan et al., op.cit.). Conductive hearing loss occurs when a disruption occurs in the auditory transmission process from the external ear to the inner systems through cartilage and tissue (Brestovci and Bolfan-Stosic, 1998; Hogikyan et al., 2000). Sensorineural hearing loss disorders occur when there is a disruption in the transmission process in the inner parts of the ear (such as the auditory nerves and the auditory processing parts of the brain) (Hogikyan et al., op.cit.).

Hearing loss may not always result in a speech or voice disorder, evidenced in the fact that distinct differences in regard to vocalization patterns between 'normally'-developed individuals and hearing-impaired individuals do not necessarily emerge until late childhood (Schneider et al., 2004). Further evidence is found from the fact that there are relatively minimal differences recorded in the vocalization patterns within the child population irrespective of the children's hearing abilities (Scheiner et al., op.cit.). When a hearing impaired child is provided with a hearing aid at as early stage as possible, the child's vocal behaviours usually remain 'normal' and healthy (Kiesel-Himmel and Ohlwein, 2003).

2.10 Psychological factors

A subset of children with speech, voice or singing disorders does not possess any apparent physiological abnormality and they seem to be in control of their voice mechanism (Baker, 2002a, b). With such individuals, the underlying causal and contributing factors behind the disorders are of psychological origin (Baker, op.cit.; Blood et al., 2007; Bouwers and Dikkers, 2007; Butcher et al., 2007; Carding et al., 1999; Coster et al., 1999; Davis, 2007; Davis et al., 2006; Fox et al., 2002; French, 2006; Hamdan et al., 2007; Heitmann, 2004; Hielscher, 2004; Sederholm and McAllister, 2001; Van Borsel et al., 1999; Weber-Fox, 2001). For instance, a voice disorder may also be a symptom of anxiety due to the fact that our voices reflect our emotional states (McAllister, 1997; Sederholm, 1996).

There has been debate over whether psychological factors are the original causal or contributing factors to speech and voice distortions or whether such factors are influenced by such disorders (Blood et al., 2007; Connon et al., 2007; French, 2006; Roy and Bless, 2000). There may be a cycle of cause-and-effect in function that can work either way (Fox et al., 2002; Weber-Fox, 2001). For instance, factors in adult population, functional dysphonia and vocal nodules are closely connected to psychological factors within a complex cycle of cause-and-effect (Baker, 2002a; b; Roy and Bless, op.cit.).

Psychogenetic speech and voice disorders (i.e. primarily originating from psychological factors) are the results of disturbances in a child's psychological state, which in turn interferes with the individual child's phonation ability and, subsequently, his/ her voice quality (Connon et al., 2007; Jacobson et al., 1997; Kooijman et al., 2005; Thurman and Klitze, 2000). For instance, a conversation disorder establishes itself as a variety of neuropsychobiological symptoms originating from a psychological disturbance (Butcher et al., 1987; Thurman and Klitze, op.cit.). Such psychological disturbances affect the individual's voice mechanism through neural networks, which connect physiological and psychological sides to one another and, finally, result in distorted voice quality (Butcher et al., 1987; Rubin et al., 2003; Thurman and Klitze, op.cit.).

From a clinical perspective, therefore, psychogenetic speech and voice disorders are commonly divided into two separate categories: a) muscle tension dysphonia as a result of a laryngeal infection combined with simultaneous emotional stress, and b) repressed psychological stress emerged as a voice disorder (Baker, 2002a). Speech and voice disorders that originate from psychological factors are often reported prior to school-age, providing further support for the importance of administering children with speech or voice therapy at as early a stage in life as possible (Davis et al., 2006; Nienkerke-Springer et al., 2003).

Studies investigating the connections between physiological and psychological factors, as well as their connections to speech and voice disorders, require both medical examination and psychological assessment in addition to voice assessment (Baker, 2002a; b; Nienkerke-Springer et al., 2003; Rubin et al., 2003). A greater deal of the time, standardised psychological inventories and tests are used in gathering the required information (Baker, op.cit.; Freidl et al., 1993). The decision as to which inventory to adopt depends on the specific psychological factors under investigation.

Nevertheless, only a limited amount of research has been conducted on the effects of psychological factors and on children's voice quality and vocal behaviours. It is not known to what extent such factors influence children's vocal functioning and voice quality. Furthermore, it is not known whether psychological factors influence children's speaking and singing behaviours in both their speaking and singing behaviours.

2.10.1 Personality factors, behavioural patterns and emotional states

When looking at behavioural patterns, distinct differences can be recorded between individuals possessing speech or voice disorders and those not possessing such distortions (Aronson, 1985; Baker, 2002a; Butcher et al., 1987; de Cuyper, 2007; Ezrati-Vinacour and Levin, 2004; Hamdan et al., 2007; Horsley and FitzGibbon, 1987; Karrass et al., 2006; Sederholm, 1996; Virokannas, 1997). Children possessing psychogenetic speech or voice disorders often exhibit a greater amount of aggressive behaviour than their peers with 'normal' and healthy vocal functioning do (Sederholm, op.cit.). Speech and voice disorder sufferers also come across as immature and less able to handle stressful situations than their peers (Butcher et al., op.cit.).

It should be noted, however, that personality characteristics have not always been related to voice distortions in adults (Prachali, 2007). Individuals of particular personality types (mainly those characterised as nervous, shy, withdrawn, tense and anxious) are more likely to develop speech or voice distortions since their personalities are constructed on self-critical and defensive characteristics that are often regarded socially-undesirable (Baker, 2002a; b). Hyperactivity and extraversion have been associated with voice disorders (Hamdan et al., 2007; McAllister, 1997; Sederholm, 1996). Children who possess distorted and unhealthier voice quality exhibit a greater amount of 'acting out' behaviour in comparison to their peers with 'normal' and healthy vocal functioning (Hamdan et al., op.cit.; Horsley and FitzGibbon, 1987; Virokannas, 1997). In addition, children suffering from attention-deficit hyperactivity disorder are also prone to developing unhealthy vocal functioning and voice quality (Hamdan et al., 2007). Furthermore, children who are sociable in nature and possess a number of friends are more prone to developing voice disorders primarily due to subjected voice abuse (Roy et al., 2006). In such studies, personality characteristics are assessed for with the use of standardised personality assessment protocols (such as the Eysenck Junior Test) (Roy et al., op.cit.).

Furthermore, behavioural and learning difficulties have been associated with speech and voice disorders (Coster et al., 1999; Koivusaari, 1998; Roy et al., 2007; Virokannas, 1997). For example, dyslexics are more likely to exhibit distorted voice quality than their 'normally'-developed peers (Koivusaari, op.cit.). Such studies have focussed on comparing children with diagnosed behavioural and learning difficulties with children without such diagnosed difficulties. Another example is children who suffer from psycho-sociological or learning difficulties and often also exhibit hoarse voice quality (Virokannas, op.cit.). Moreover, connections have been recorded between general cognitive abilities (such as ability to concentrate and to memorise) and vocal functioning (Virokannas, 1997). However, it may be difficult to determine whether a behavioural or learning difficulty is causing a child's speech or voice to become distorted, or whether a speech or a voice disorder is causing the child's behaviour or one's ability to learn to become distorted.

Moreover, voice disorders are, at times, associated with minor or more severe forms of acute or chronic emotional stress (i.e. emotional immaturity, depression or neurotic life-adjustment) (Butcher et al., 1987; de Cuyper, 2007; Davis, 2007; Diem Groeneveld, 2007; Laukka, 2004; Leppanen and Hietanen, 2001). Emotional states may have an influence on different voice parameters (such as breathiness), potentially resulting in different types of voice disorders (such as excessive breathiness) (Sundberg, 1987). Emotional fluctuations may affect the vocal timbre, vocal volume or the pitch of the child's voice (Butcher et al., op.cit). A child's voice is a reflection of the child's emotional state, particularly during the formative years of childhood (Bolfan-Stosic et al., 1998). In relation to such a claim, brain processes responsible for perceiving and responding to emotional elements are closely connected to higher cerebral functions concerned with vocalisation (Gordon, 1996). For instance, hyper-contraction of both intrinsic and extrinsic laryngeal muscles is a common reaction to emotional stress, subsequently influencing the individual's final vocal product (Mathieson and Greene, 2003).

More specifically, Sundberg (1987) stated that particular alterations can be recorded in articulation processes and in laryngeal and respiratory structures in relation to ten specified emotional states. Aronson (1985) placed importance on the role that psychological factors play on relation to vocal functioning on the basis of the fact that such factors influence intrinsic and extrinsic laryngeal muscles via nervous, endocrine and immune systems. The larynx is subsequently exposed to emotional stress (Aaronson, op.cit.). Mental disorders, therefore, also inevitably influence an individual's vocal functioning and vocal products through such networks (Mathieson and Greene, 2003). However, the exact connections between personality traits, behavioural patters and vocal functioning are not known. Furthermore, it is not known whether such factors are connected to children's vocal functioning and voice quality in regard to both their speaking and singing behaviours.

2.10.2 Biography

Biography (i.e. feelings of self-identity, self-esteem and self-efficacy) is closely connected to voice quality and vocal functioning in any vocal behaviour (Baker, 2002b; De Jong et al., 2007; Fuchs et al., 2007; Kersner and Wright, 2002). Voice-disordered children tend to possess lower levels of self-esteem than their peers with 'normal' and healthy vocal functioning do, as indicated by studies exploiting standardised methods as to assessing for such factors (such as the Eysenck Junior Personality Test) (Decoster, 2007; Virokannas, 1997). Such a differentiation can be recorded due to fact that the input the child receives from his/ her family, as well as the attitudes of significant people around the child, affects the child's final vocal functioning in a significant way though their impact on the biographic factors (Baker, op.cit.). Therefore, voice distortions are likely to lead to negative feedback and, subsequently, in lower self-esteem (Baker, 2002a). In addition, more extensive voice use and vocal training are likely to result in more confident voice use and, subsequently, healthier vocal functioning and voice quality (Fuchs et al., op.cit.). Such findings have been arrived at through analysing interview, questionnaire and observation data. It should be noted that awareness of speech and voice disorders is, unfortunately, limited within the general population, often resulting in the speech or voice-distorted child receiving negative feedback from others (Van Borsel et al., 1999).

Furthermore, when a child receives negative feedback from others, the voice disorder may deteriorate as a result of emotional upset or lowered self-esteem (Bolfan-Stosic et al., 2002). For instance, a child with an excessively nasal voice quality may receive negative feedback from others, subsequently deteriorating the child's psychological state and further being reflected in the child's vocal output (Buck et al., 2002). Such interplay of factors may lead to a circle of cause and effect that may be difficult to break. Children with speech or voice disorders are viewed in more negative terms by their peers and often by adults in comparison to their peers with 'normal' and healthy vocal functioning (De Jong et al., 2007; Virokannas, 1997). Moreover, the way a child feels about his/ her voice plays a significant role in shaping the child's perceptions of identity, self-esteem and self-efficacy (Bolfan-Stosic et al., 2003). Such claims indicate that 'abnormal' vocal functioning and voice quality may have significant psychological impact on a child (Baker, 2002a; Mathieson and Greene, 2003). Nevertheless, the extent to which such factors influence one another is not known. Furthermore, it is not known whether biography is connected to vocal functioning and voice quality in both children's speaking and singing behaviours.

2.10.3 Family factors

Mother-child interaction has a significant influence on children's vocal functioning and voice quality (Fox et al., 2002; Green, 1998; Papousek, 1996; Welch, 2005). The first auditory sounds that the child is exposed to are maternal utterances that represent the acoustic sound of the child's local culture (Papousek, op.cit.; Welch, op.cit.). Consequently, such sounds possess a considerable impact on the developing child's perceptions of appropriate voice use (Papousek, 1996; Welch, 2005). For example, perceptual and acoustic differences can be recorded between children belonging to lower socioeconomic status families and those belonging to higher socioeconomic status families in regard to children's voice use and voice quality, primarily due to the differences recorded in the linguistic factors the child has been exposed to early on in life (Fredman and Centeno, 2006; Marshall et al., 2006). Such studies have investigated the voice data primarily through perceptual voice assessment, with such assessment being complimented by acoustic voice data. The interaction between the mother and the foetus exclusively determines the child's early responses to external auditory stimuli as a result of the interfacing of the maternal and the foetal bloodstreams (Van der Wel, 2007; Welch, 2005).

In fact, 20 per cent of children diagnosed with a speech or a voice disorder have a family history of such disorders (McAllister, 1997). Nevertheless, the child's disorder may not be exactly the same as with other family members (Fox et al., 2002). Most often, the child has learnt to imitate his/ her family members in speaking, which has subsequently resulted in faulty learning patterns and distorted speech (Wilson, 1987). Evidence for such claims is derived from studies with stutterers who have begun to show distorted speaking patterns at a very early stage in their life when one or both of their parents have exhibited distorted speaking patterns (Buck et al., 2002).

Stimulation for both speaking and singing received from appropriate atmosphere at home, as well as from exposure to linguistic experience in early childhood, are likely to affect a child's vocal development positively (Kersner and Wright, 2002). Language environment at home is extremely important for healthy vocal development since the degree of stimulation the family provides for the child forms the basis for subsequent vocal development (Bolfan-Stosic et al., 2003; Deliyski, 2004; Demany and Semal, 2002; Fletcher and Hall, op.cit.; Marshall et al., 2006; Salameh, 2006). Such conclusions have been arrived at through comparative studies focussing on investigating different family environment with the use of: interviews, questionnaires, observation and speaking tasks. The findings indicate that speech disorders may be a learnt habit, simultaneously providing indication for psychological and sociological factors possessing an impact on children's vocal functioning and voice quality. Nevertheless, it is not known to what extent the factors influence one another nor whether the same factors influence children's vocal functioning and voice quality in both speaking and singing behaviours.

Furthermore, Mathieson and Greene (2003) argued that considerable differences can be recorded in the temperaments between newly born babies and older infants subsequent to the children having been exposed to their family environment. Disturbed family relations have been claimed to be a major causal factor for voice disorders (Nienkerke-Springer et al., 2003; Robb et al., 2005). Children (in particular boys) from divorced families exhibit a greater amount of emotional instability (Nienkerke-Springer et al., op.cit.). There is also a greater prevalence of speech and voice distortions found amongst children with divorced parents than with parents who live together (Bohm, 2004). Such findings have been gathered through comparative studies between different types of family systems that have relied on: interview, survey, observation and voice data.

The arguments indicate that anxiety and other psychological factors within the family system significantly shape children's vocal functioning and voice quality. A variety of psychological factors may interact with a child's personality characteristics and, subsequently, cause the child's vocal functioning and voice quality to become distorted (Dietrich, 2007; Michiel, 2007). It is not known, however, whether such factors equally influence children's speaking and singing behaviours.

2.11 Sociological factors

Psychological factors are closely connected to social factors, with all such factors integratedly influencing children's vocal functioning and voice quality in all vocal behaviours (Barlow and Howard, 2002; Bolfan-Stosic et al., 1998; Bouwers and Dikkers, 2007; Fletcher and Hall, 1992; Nienkerke-Springer et al., 2003). The family system (as described above) is a good example of a phenomenon that deals with both psychological and sociological factors (see Section 2.11.3) (Bolfan-Stosic et al., op.cit.; Nienkerke-Springer et al., op.cit.). Nevertheless, sociological factors on their own can also significantly influence a child's vocal functioning and voice quality in any vocal behaviour.

2.11.1 Gender

Gender differences have been recorded in children's vocal behaviours (Bodt, 2007; McAllister, 1997; Rauhala, 1991; Sederholm, 1996; Virokannas, 1997). Boys use their voices slightly differently from girls (De Jong, 2007; Rauhala, 1991; Virokannas, 1997). For example, girls tend to speak with quieter voices and boys tend to shout more than girls (Virokannas, op.cit.). Both perceptual and acoustic voice analyses have been exploited in such studies.

Nevertheless, voice distortions persist in girls for longer periods of time in comparison to boys (Bodt, 2007; De Jong, 2007). It may be, therefore, that girls need more prompt voice disorder treatment in order to prevent such distortions from persisting into puberty and adulthood. More specifically, the prevalence of voice disorders is higher amongst boys than amongst girls (McAllister, 1997; Sederholm, 1996). It is also known that there are differences between singing behaviour exhibited by boys and that exhibited by girls (Welch et al., 2008). However, none of the existing studies simultaneously investigate children's speaking and singing behaviours.

2.11.2 Linguistic environment

The linguistic environment that a child grows up in inevitably shapes the child's vocal functioning and voice quality in any vocal behaviour (Papousek, 1996; Ter Doest, 2007). A child's first language shapes the child's customary speaking and singing behaviours, further influencing the quality of the child's voice in both speaking and singing behaviours (Altenberg and Ferrand, 2006; Bolfan-Stosic et al., 2003; Iversen and Ohgushi, 2006; Mang, 2001; Van Bezoojien, 1995; Van der Wel, 2007). For example, in particular cultures (such as in Asia), women speak with high-pitched voices, whilst in other cultures (such as in northern Europe), women tend to speak with low-pitched voices (Van Bezoojien, op.cit.). Such differences are results of the children's first language, as well as products of cultural conditioning.

Distinct differences in vocal functioning and voice quality have been recorded between monolinguals and bilinguals (Klein et al., 2006b). Such differences occur due to the fact there are differences in the ways in which bilinguals process the languages that they speak (Klein et al., op.cit.). Such differences subsequently influence the children's vocal functioning and voice quality. In addition, pressure placed on the articulation processes magnifies when a child speaks an additional language, which further influences the child's vocal functioning due to the added pressure in the voice mechanism and the voice production process (Klein et al., 2006b; Rethfeldt and Miller, 2006). For instance, bilinguals often raise the pitch of their voice when they speak in their second language, subsequently influencing their voice quality (Altenberg and Ferrand, 2006; Rethfeldt and Miller, op.cit.). It should be noted that it is not known whether linguistic environment has the same effect on both children's speaking and singing behaviours.

2.11.3 Environmental influence

A calm and quiet environment at home and at school is crucial in preventing voice disorder from manifesting themselves, based on the fact that background noise may lead to voice strain due to the fact that a child needs to raise his/ her voice in order to be heard (Birgander, 2007; Calcinoni, 2007; Carding et al., 2006; Deliyski et al., 2005; Hunt and Slater, 2003; Sodersten et al., 2005; Ternstrom et al., 2005; Timmermans, 2007; Van Luin, 2007). When a child is exposed to a great deal of background noise at home, /for example, due to the fact that the child has a large family that talks and shouts at each other) the child may develop poor vocal habits (such as tense voice production) (Carding et al., op.cit.; McAllister, 1997). For instance, fighting with siblings has been reported to be a significant contributing factor for children's voice disorders (McAllister, op.cit.). A greater number of older siblings have been reported to raise the likelihood of a child developing a voice disorder (Carding et al., 2006).

Children living in urban settings generally exhibit a greater number of voice distortions than children living in rural areas do due to the fact that air-pollution and noise in the living environment are likely to pose deteriorating effect on children's voices, as evidenced through perceptual and acoustic voice analyses (Sederholm, 1996; Speciale and Cimino, 2000). Shouting and speaking out of 'normal' vocal register are considerable causal factor for child hoarseness (Bolfan-Stosic et al., 1998). Such findings have been found through assessing children behavioural patterns via observation, interviews with the children's parents and teachers, as well as with the use of standardised instruments designed for behavioural assessment. Furthermore, the acoustical environment at school and at home may not be appropriate, posing excess demand on children's voice (Rothman et al., 2002; Rantala et al., 2002). For instance, when the

classroom has an echo after-effect, children may need to increase their vocal volume in order to be heard and understood by others (Rantala et al., op.cit.).
Moreover, sociolinguistic factors operating in a child's speaking and singing community shape the child's vocal output (Welch, 2005; Whiteside and Hodgson, 1999). For instance, vocal changes taking place in adolescence are not only results of physiological changes taking place during puberty but they are also products of sociolinguistic conventions operating in the child's culture (Whiteside and Hodgson, op.cit.). Values in society are regarded as extremely influential in shaping children's cognitive development, for instance, through social interaction (Skelton, 2004; White, 2001). However, it is not known whether such influences extend to both children's speaking and singing behaviours.

2.11.4 Educational environment

Educational environment plays a crucial role in shaping children's vocal functioning (Morton and Watson, 2001; Virokannas, 1997). Morton and Watson (2001) claimed that poor voice quality exhibited by teachers influences children's listening performance in the classroom negatively and, subsequently, children's ability to learn due to the fact that a larger part of the children's cognitive capacities are dedicated to perceptual functioning when trying to comprehend what the teacher is saying rather than to comprehension of the actually subject matter. Too great an amount of demand is also placed on the child's listening skills, resulting in poor comprehension (Morton and Watson, op.cit.). The findings were gathered through the use of standardised test focussing on children's cognitive abilities and through comparing children of different cognitive abilities against one another, whilst taking the teacher's voice quality into consideration. The findings indicate that the quality of a teacher's voice may indirectly influence children's learning ability. In addition, teachers with unhealthier voice quality may provide poor vocal models for the children (Virokannas, op.cit.).

Furthermore, during lessons (particularly during music lessons), teachers should match their students with tasks that suit their ability levels (Welch, 1994). When the demand of the tasks are set too high, children may lose motivation to learn, resulting in inefficient and inappropriate singing ability and potentially leading to voice distortions (Welch, op.cir.; 2005). Peer pressure may also be a contributing factor for distorted vocal functioning and voice quality (Welch et al., 1997). For instance, a child's singing ability may deteriorate when such activities are not regarded as desirable to engage in, subsequently leading to a lack of practice and to diminished singing development (Welch, 1994). Boys often exhibit reluctance to engage in singing activities, perhaps due to the traditional association of music and singing activities with female teachers (Welch et al., op.cit.). Lack of singing engagement and varied voice use may, subsequently, result in speech or voice disorders on a long run (Welch, op.cit.). A nurturing environment has been claimed to be vital for healthy development in both speaking and singing behaviours (Welch, 2005).

2.12 Consideration of holistic factors in practice

Since the original causal factors behind speech and voice disorders may not necessarily be of a physiological origin (Andrews, 2007; Bouwers and Dikkers, 2007; Decoster, 2007; Dejonkere, 2007; Freidl et al., 1993; Hunt and Slater, 2003; Mathieson and Greene, 2003; Schalen et al., 1999), a treatment approach targeting such factors may not be effective in treating a child's speech or voice disorder. For instance, Schalen and her colleagues (op.cit.) reported that 35 per cent of adult patients referred to voice therapy did not possess any form of a physiological abnormality underlying their distorted vocal output (see Figure 2.3 below).

Thus, the consideration of the whole person (i.e. physiological, psychological and sociological aspects) in assessing for potential causal and contributing factors behind a speech or a voice disorder has been supported by a number of professionals (Andrews, 2007; Stemple, 1993; Thomas, 2007; Thurman and Welch, 2000). The argument has been that all of the above factors are connected to our vocal functioning and voice quality. Such arguments are supported by the fact that physiological body and psychological sides are connected through neural networks (see Section1.9.4) (Thurman and Welch, op.cit.). Therefore, the original causal factor (such as a psychological factor) may be causing an imbalance in the individual's holistic entity (i.e. both physiological and psychological functions), further being reflected in vocal functioning and voice quality.

The above claims provide indication for the importance of considering the child voice as a holistic entity in both its assessment and treatment. However, it is not known whether professional therapists and teachers take all of such factors into consideration in their practice. Moreover, it is not known whether such factors influence children's speaking and singing behaviours equally. It may be that particular factors influence speaking behaviour to a greater extent than they influence singing behaviour, whilst other factors may influence singing behaviour to a greater extent than speaking behaviour.

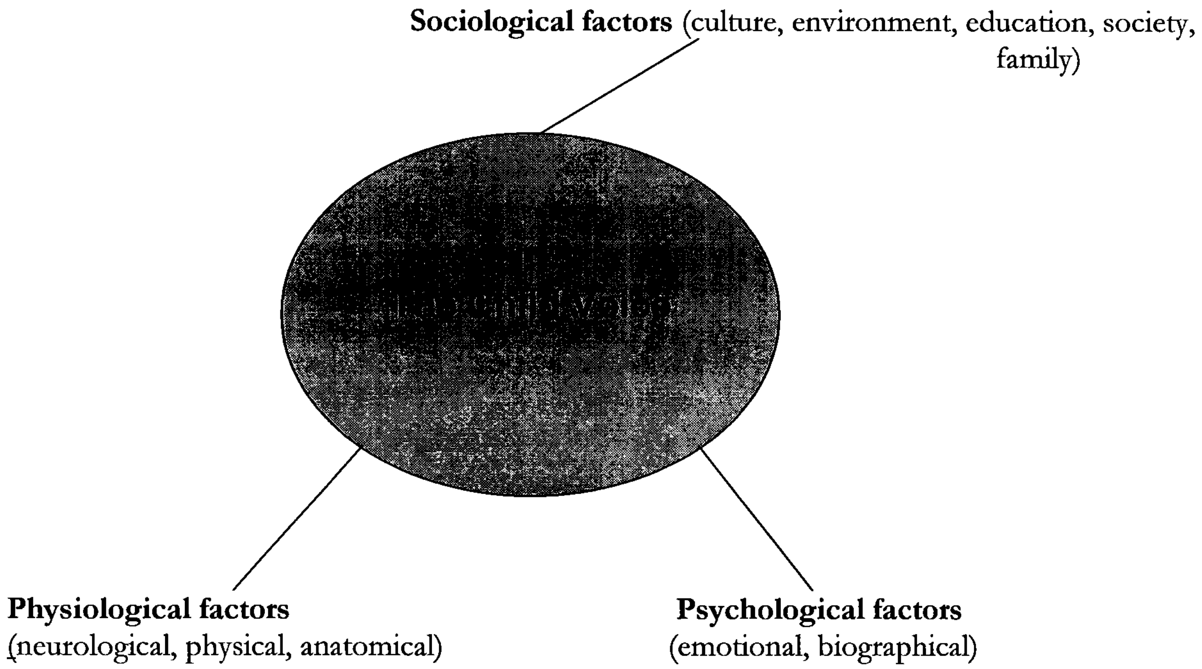


Figure 2.3: Model for holistic factors and the child voice

2.13 Implications for the study

The discussion on holistic factors indicates that there is a lack of knowledge on children's vocal functioning and voice quality (see Sections 2.9-2.11). Therefore, the following research questions were formulated for the study:

- Are children's overall voice quality and vocal functioning influenced by a variety of holistic factors (such as those of physiological, psychological and sociological origins)?

- Do the same holistic factors influence children's speaking and singing behaviours, or do such factors differ according to the vocal behaviour in question?

Chapter 3: Connections between children's speaking and singing behaviours: potential exploitation of such connections in education ad therapy

3.1 Introduction

In Chapter Two, different causal and contributing factors for children's speech and voice disorders were discussed. In order for administered intervention for such disorders to be successful, therapeutic methods focussing on the causal and contributing factors behind these disorders need to be implemented.

In this Chapter, it is demonstrated theoretically why singing could potentially be used as such a method. Theoretical arguments are provided as to potential connections between children's speaking and singing behaviours in order to highlight the potential use of singing in such settings (see footnote 1).

3.2 Potential connections between speaking and singing behaviours

Speaking and singing behaviours have generally been regarded two distinct sets of vocal behaviours by professional speech and voice therapists, teachers and the general public (Kersner and Wright, 2002; Rubin et al., 2003; Welch, 2005). Traditionally, speech and language therapists have focussed on speaking behaviour when assessing and treating a child client despite the fact that it may be the child's singing behaviour that is causing the child's voice to be distorted (Hegde, 2007; Rubin et al., op.cit.; Wilson, 1987; Welch, 2005). For instance, a subset of children exhibit vocal distortions when they speak but not when they sing (Elias et al., 1983; Rubin et al., 2003).

Footnote 1: Key features of this Chapter have been published in the Journal of Voice. See publication: Rinta, T. and Welch, G.F. (2006). Should singing activities be included in speech and voice therapy for pre-pubertal children?. 17(2), 100-112

Moreover, according to the voice-scientific view, our speaking and singing behaviours exploit the same voice as their main instrument (Thurman and Welch, 2000), with our voices being highly sensitive to both external and internal influences (Baker, 2002b; Stacy et al., 2002). Such potential connections between speaking and singing behaviour from the physiological, neurological, psychological and sociological perspectives are provided below.

3.3 Connections between speaking and singing behaviours from the sociological perspective

Humans have been exploiting their voice mechanism for vocalisation for centuries (Newman, 1986). Originally, all vocalisation (including speaking and singing) was used as a means to survive and to communicate with fellow humans (Bores, 1984; Newman, op.cit.). Such a function resembles the function of voice use amongst other vertebrates (Kirchner, 1988) and indicates that all vocal behaviours share a common root.

Vocal development and musical development have been argued to be connected. Our musical development is shaped by our surrounding musical environment, in particular by the musical action specific to one's culture (Birkenshaw-Flemming, 1989; Dobbs, 1990; Iversen and Ohgushi, 2006; Lohmander et al., 1998; Sell, 2005; Sloboda, 2000; Stacy et al., 2002; Ter Doest, 2007). All musical activities are characteristics of communities, evidenced in individual cognitions and behaviours found in the social interactions of that particular culture (Cross, 2002). Stimulation from one's musical environment is essential for developing musical (including singing) skills, given the fact that one learns to speak and sing according to the input one receives from such social interactions (Dobbs, op.cit.). With regard to these two vocal behaviours, cultural differences are recorded as to whether such behaviours are perceived as separate or as integrated entities (Welch, 2005). In some cultures (such as in Western countries), singing and speaking are regarded as two distinct sets of behaviours, whilst in other cultures (such as in Asian countries), they are regarded as being closely interwoven (Welch et al., 1996). Such studies investigating cultural differences in vocal behaviours have addressed a comprehensive mixed method approach (such as a combination of neurological investigation, interviews and local observation) in gathering their data.

By the age of six, children have usually learnt to distinguish between speaking and singing behaviours when such distinctions operate in their culture (Laurence, 1999; McMullen and Saffron, 2004; Welch, 2005). Reasons for the differentiation between cultures are a) the Western concentration on notation is likely to diminish spontaneous singing activities, leading to constrained vocal expression abilities (Sloboda, 2000); b) linguistic elements that may be distinct from musical sounds or closely resemble such sounds (Mang, 2001); c) motherese that mothers speak to their children and that may vary from culture to culture (Papousek, 1996); and d) nursery rhymes that may either facilitate or diminish singing culture in one's society (Laurence, op.cit.). Therefore, children learn to relate to speaking and singing behaviours in particular ways, according to their local and global cultures.

The above differences are connected to the fact that our cultural experiences shape the development and the function of the anatomical and physiological structures required for voice production (Brown et al., 2004; Welch, 2005). Such experiences also shape the neuropsychobiological networks responsible for the initiation and the interpretation of any auditory stimuli (Brown et al., op.cit.; Welch, op.cit.). For example, differences in articulation can be recorded between individuals speaking different languages as their mother-tongue due to the individual's differing cultural and linguistic exposures (Bruyninck et al., 1994; Ter Doest, 2007).

3.3.1 Cultural influences

The connection of cultural factors to children's speaking and singing behaviours have been found to be considerable. The common root that speaking and singing behaviours share is evident in the fact that musical perception is related to the perception of patterns found in speech (Welch, 1994). Levman (1992) supported such claims by stating that all musical behaviour (including singing) and speaking are similar in function, based on the fact that they require the acts of hearing and producing sound, originally developed for the purpose of survival. Furthermore, the fact that a number of individuals learn to sing before they learn to speak indicates that these two vocal behaviours are interconnected (Moog, 1968).

Studies concerning our early vocalisation advocate potential connections between speaking and singing behaviours. We are exposed to auditory stimuli from a young age. Thus, infants tend to prefer musical and vocal sounds that they are familiar with (such as traditional songs from their own culture) (Papousek, 1996). This happens due to the fact that they are more able to comprehend familiar musical stimuli and, therefore, are able to attend to it (Lamont, 2002; Papousek, op.cit.). Social surroundings inclusively determine the infant's early vocalisation sounds as either speech- or singing-like (Hewstone et al., 1996; Ruzza et al., 2002). Studies investigating infants' early vocalisation have relied on both perceptual and acoustic voice analyses in different cultures (Papousek, 1996). The infant's first cries, babbling and vocal sounds develop into spoken or sung vocal output (Fourcin, 2005; Mathieson and Greene, 2003) that is subsequently divided into two separate categories (i.e. speech and singing) or it is perceived as a continuum. Particular emphasis is placed on the vocalisation of the infant's mother in shaping the infant's perception of any auditory sound (Fourcin, op.cit.; Mathieson and Greene, op.cit.). In all cultures, mothers tend to speak to their children in particular ways. Such characteristic speech is known as motherese and it consists of speech patterns that resemble singing (Papousek, op.cit.; Sandbank, 1989).

As a result of the mother-child interaction, the child is exposed to singing from a very early age. Only later on in life, the child's singing ability may diminish when it has not been facilitated by the child's culture sufficiently (Peretz et al., 2004; Welch, 2005). By the age of one or two, children are usually able to sing spontaneously, with their habit to sing beginning to develop (Moog, 1968). By the age of six, children usually know a number of songs from their own cultures (Peretz et al., op.cit.). Based on such claims, the early years of childhood are regarded as a significant period in forming a firm ground for all vocal behaviours.

Cultures with oral music traditions that exercise singing educate children in perceiving speaking and singing as equally communicative behaviours (Welch, 2005). Early exposure to musical stimuli educates children in a number of ways. For example, a child is likely to develop an ability to imitate sung pitches (Welch, 1985), and the child learns to exploit their voice in a variety of ways (Mathieson and Greene, 2003). Encouragement for using one's voice in a variety of ways is vital in developing efficient vocal functioning and a healthy-sounding voice (Sloboda, 2000). From a cultural and sociological perspective, therefore, it may be more beneficial to view music, singing and speech as a continuum rather than as separate categories, based on the fact that considerable overlap can be recorded between their components and functions (Cross, 2002).

Furthermore, musical (including singing) activities derive their meanings from their cultural contexts (Cross, 2002). Thus, a child's vocal behaviour can potentially be altered through modifying the child's local cultural surroundings (such as input from the child's family and the child's school). For instance, when a child feels comfortable in singing with a particular group of people, the child's distorted speaking ability may be enhanced by encouraging the child to speak in a similar social setting (Thurman and Welch, 2000).

Moreover, feedback from a child's local culture significantly influences the child's vocal functioning (Welch, 2005). For example, negative feedback received for one's singing ability may influence a child negatively and a child may decide to refrain from singing activities (Welch, 1985). Furthermore, individuals surrounding the child provide role-models for voice use, implying that local cultural environment plays a significant role in shaping the child's vocal functioning (Welch, 1998). All of such factors influence the child's final vocal products in both their speaking and singing behaviours.

Cultural factors also shape the emotional elements that are similar in speaking and singing behaviours. Emotional prosody is one of the most basic features of speech (Thurman and Gramsch, 2000). Since singing performs an emotionally-expressive function (Welch, 2005), further connections between speaking and singing are found when exploring emotional elements connected to these vocal behaviours (Magne et al., 2002). More specifically, the interaction between the mother and the foetus influences the child's emotional reactions to any auditory stimuli (including speech and singing) (Thurman and Gramsch, op.cit.). Such reactions are further shaped by the individual's subjective experiences of their own voice (Welch, op.cit.).

In summary, the above arguments indicate that all vocal behaviours (i.e. speaking, singing, any form of vocalisation) share the same root and are interconnected from the cultural perspective. Such arguments imply that it may be possible to influence the quality and the functioning of one type of vocal behaviour (such as speaking) through the other (such as singing), on the basis of the cultural perspective.

3.3.2 Integrated cultural and societal influences

In addition to cultural influences, factors from a child's society influence the development of the child's vocal behaviours (see footnote 2). By the time a child enters school, the child has learnt a considerable amount of information, skills and abilities (including speaking and singing abilities) in an implicit way, based on their previous life-experience (Birgander, 2007; Bunning, 2004;

Brown et al., 2004; Costa-Giomi, 2002). An example of such implicit learning is singing in harmony. In Western societies, children do not necessarily learn to sing in harmonic progression, whilst harmonies form a part of everyday communication in African societies (Thurman, 2000). Consequently, African children develop sensitivity to harmonies, whilst children from Western cultures are less likely to develop such sensitivity. Moreover, passive enculturation (i.e. implicit learning) from a child's culture significantly influences a child's ability to process any auditory sound, indirectly influencing the child's subsequent vocal functioning (Bunning, op.cit.; Drake and El Heni, 2002).

It may be easier to educate children, rather than adults, in using their voices correctly since children may be more responsive to the administered speech and voice-disorder treatment than older sufferers, as indicated in early-years' education research (Moog, 1976). Further support is derived from the fact that children undergo rapid cognitive development, as evidenced through data gathered with the use of a variety of cognitive tests, due to which they may be more susceptible to learning new skills and behaviours than older sufferers (Moog, op.cit.).

Cultures with oral music traditions that exercise singing educate children in perceiving speaking and singing as equally communicative behaviours (Welch, 2005). Early exposure to musical stimuli educates children in a number of ways. For example, a child is likely to develop an ability to imitate sung pitches (Welch, 1985), and the child learns to exploit their voice in a variety of ways (Mathieson and Greene, 2003). Encouragement for using one's voice in a variety of ways is vital in developing efficient vocal functioning and a healthy-sounding voice (Sloboda, 2000). From a cultural and sociological perspective, therefore, it may be more beneficial to view music, singing and speech as a continuum rather than as separate categories, based on the fact that considerable overlap can be recorded between their components and functions (Cross, 2002).

In summary, the above arguments indicate that all vocal behaviours share the same ontology and, therefore, are interconnected from a sociological perspective. Such arguments provide theoretical support for benefitting from relying on singing activities in enhancing children's speaking ability and their overall vocal functioning. Through singing activities, children may become more aware of their vocal functioning and voice production process, potentially indirectly enhancing their vocal output.

Footnote 2: Culture can be defined as patterns of human activity within a society (Wikipedia – www.wikipedia.org). Society can be defined as a grouping of individuals characterised by common interests, distinct culture and distinct institutions (Wikipedia – www.wikipedia.org).

3.3.3 Social influences and neurological shaping

From the neurophysiological perspective, musical processing (including the processing of singing) overlaps with a number of biological functions in our bodies (Cross, 2002). Members of a given society develop biological and neurological pre-dispositions to the music present in their culture (Welch, 2005). Therefore, the symbolic and affective meanings of such music influence the individuals' psychological state (Plantinga and Trainor, 2002; Welch, 1998). Further evidence for such claims is found from the fact that humans are educated to make sense of music according to its psycho-acoustic features that influence our psychological states (Thurman, 2000). For instance, each type of music consists of specific musical elements that have been constructed according to cultural and social norms (Cross, op.cit.). Such elements influence the listener in a variety of ways via neurological processing. Similar neurological processes are also needed in the comprehension of speech and singing (Welch, 2005). The specific neurological processes for each element are not fully-known despite comprehensive neurological investigating in the field (Welch, op.cit.).

Moreover, similarities can be recorded between the processing of speech and music (Saffran, 2002). Speech prosody (i.e. the patterns of sounds present in speech) and musical melody are processed in similar ways, indicating that the two are likely to be connected (Magne et al., 2002). More specifically, prosody in speech is recognised according to its paralinguistic cues (such as pitch variations) that emphasise the syntax and the semantics of the utterance (Thompson et al., 2002). The communicative function of rhythm is also significant in making speech meaningful (Moog, 1968). Therefore, our first musical and speaking experiences concern rhythm and melody, suggesting that there is an inter-connection between speaking and singing through these particular elements (Welch, 2001). The processing of pitch is also essential in order to comprehend both speech and singing (Peretz and Coltheart, 2003). Furthermore, since speech and music are integrated in singing (Saffran, op.cit.), singing activities may facilitate one's ability to speak when focussed on the properties that music and speech share.

Early education determines our perception of pitch variations in all auditory stimuli, including speech and singing (Demorest and Morrison, 2002; Moog, 1968; Welch, 1998). Such auditory stimuli are categorised either as speech or singing sounds according to their dominant acoustic features that match one's socially-constructed interpretation (Welch, 2005). Such categorisation primarily takes place in terms of the relative pitch of the auditory stimuli, providing support for the inter-connections between speaking and singing through their shared elements (Plantinga and Trainor, 2002). It may be, then, that children can be educated to listen to (as well as to imitate) both spoken and sung passages (Welch, op.cit.).

Moreover, through improving a child's auditory skills via the use of singing activities, for example, the child's vocal products can potentially be enhanced (Thompson et al., 2002). The above arguments provide theoretical evidence for the potential exploitation of culturally and socially-shaped neurological networks in speech and voice therapy settings, based on the fact that speaking and singing processing overlaps within such networks.

3.4 Connections between speaking and singing from the neurological perspective

As mentioned in Section 3.2.3, specific neural networks process all auditory sound. A great deal of information on how the brain processes music has been found from studies examining singing abilities (Avanzini et al., 2003; Peretz et al., 2004; Sell, 2005). In fact, Davis (2005) argued that our brains have evolved to facilitate singing. Therefore, studies concerned with singing may be of great benefit when investigating our cognitive abilities and the functioning of our brains. Although language and speech are primarily processed in the left hemisphere of the brain and specific musical features (such as melody) are similarly processed in the right hemisphere, music and language employ several similar neurological features, as discussed below (Patel, 1998; Peretz and Coltheart, 2003; Wong et al., 2004; Zatorre et al., 2002).

3.4.1 Brain processes for language, speech and singing

It is difficult to draw clear distinctions between the cognitive processes that concern, those that concern speech and those that concern singing due to their shared elements that are processes when exposed to any vocal stimuli, based on the fact that they share specific features (Bower and Parsons, 2003; Fourcin, 2005; Minciacchi et al., 2003). For instance, it has been reported that singing and speech are partially processed by the same cortical networks and that voice is bilaterally processed in a number of brain parts (Peretz, 2000; Peretz et al., 2000; Peretz and Coltheart, 2003). In addition, the cerebellum is primarily responsible for the processing of speech, whilst also being related to the processing of singing (Perry et al., 1999; Peretz and Zatorre, 2005).

Further evidence is found from the fact that a greater deal of neural activation is recorded when an individual is listening to voiced sounds than when listening to other musical stimuli, implying that larger brain areas are exploited in the processing of voiced sound (Belin et al., 2000). More specifically, the anterior part of the right superior temporal lobe plays a significant role in processing voiced stimuli (Zatorre et al., 1999). However, there appears to be a difference between the processing of simpler forms of singing and more complex forms of singing, with the former pre-dominantly being processed by the right hemisphere and the latter by both the left and the right hemispheres (Fourcin, 2005).

Broadly-speaking, the left hemisphere is responsible for the processing of language and the right hemisphere is responsible for the processing of music (Peretz et al., 2004). The hemispheric specialisation originally developed due to different acoustic cues enforcing our hemispheres to specialise in either type of auditory processing, enabling the brain to function to its full potential (Zatorre et al., 2002). Moreover, such specialisation manifested due to the fact that speech and music exploit different acoustic cues, further being reflected in their underlying neural functioning (Faienza and Cossu, 2000; Peretz et al., op.cit.; Zatorre et al., op.cit.). It is believed that the left hemisphere originally specialised in language processing due to its advantage over coding speech sounds (Zatorre et al., 2002).

Studies on brain-damaged patients have demonstrated that a complex set of neural pathways are required for musical processing (Gardner, 1977; Kalat, 1998). Such a finding seems to be particularly applicable to the processing of singing. For instance, a man who had suffered damage to his speech area in the left hemisphere exhibited limited capability in verbal expression but remained able to engage in musical (including singing) activities (Gardner, op.cit.). Another patient who suffered damage to the right frontal area of his brain was subsequently unable to sing but remained fluent in speaking (Gardner, 1977). Such studies with individuals possessing left hemispheric damage indicate that the individuals' musical behaviours remain intact despite their impaired language abilities and speaking skills (Kalat, op.cit.). Patients with right hemispheric damage, on the other hand, exhibited changes in their musical (including singing) behaviours, but not in their linguistic abilities (Gardner, op..cit.).

Furthermore, the connections between the processing of speech and melody have been explored in brain-damaged individuals through the use of singing activities. The findings indicate that melodic elements possess a facilitative function in word production with such patients (Uvsted, 1976). More specifically, it seems that all verbal production (both spoken and sung) is mediated by the same language output system that is distinct from the melodic processing system (Peretz et al., 2004). Such arguments provide further evidence for the use of melodic elements (such as those found in singing) in facilitating speech production when an individual's speaking ability has been damaged.

3.4.2 Processing of auditory input

All auditory stimuli are processed by the mid-brain, which connects the hindbrain to the forebrain (Davis, 2005). Neither music nor language processing is consigned to one hemisphere despite the fact that each hemisphere is primarily responsible for processing specific stimuli (Garner, 1977; Oster, 2002; Patel, 1998; Peretz and Coltheart, 2003; Zatorre et al., 2002). Overlap can be recorded between the functions of the two hemispheres, according to the focus of the passage (i.e. whether the focus is a musical or a linguistic element) (Patel, op.cit.).

With specific reference to music, the processing of musical elements is not solely reliant on a single neural passage but rather on a set of isolated neural components that have a potential to specialise in music (Kuck et al., 2000; Peretz and Coltheart, 2003). Musical processing is organised into two sub-systems: one responsible for pitch content processing and the other responsible for temporal component processing (Peretz and Coltheart, op.cit.). A greater amount of overlap between the processing of musical and linguistic stimuli can be observed in the pitch processing sub-system since pitch plays a part in both speech and music comprehension (Johnsrude et al., 2000; Patel et al., 1998). Rhythm also plays a role in making speech, singing and music meaningful (Thompson et al., 2002). Rhythm is an element that exploits integrated processing by both of the hemispheres (Long, 2004), indicating that it is reaching a number of brain areas.

Musical elements are processed in different brain areas, and almost the whole brain is activated in music perception (Wieser, 2000). Specific musical elements (such as melody) are also needed in speech comprehension even though they are primarily processed by the right hemisphere (Garner, 1977; Patel, 1998). Similarly, specific linguistic elements (such as syntax) play a role in musical processing, although they are primarily processed by the left hemisphere (Patel, op.cit.). Furthermore, a subset of speech elements (such as phonemes) depends on the left auditory cortical regions, whilst other speech components (such as prosodic elements) are more reliant on the processes of the right hemisphere (Zatorre et al., 2002).

The extent to which each element is processed by one hemisphere may differ from individual to individual (Baker, 2002a; Gardner, 1977; Kalat, 1998; Peretz and Coltheart, 2003; Zatorre, 2007). For instance, brain activity between formally-accomplished musicians and non-musicians (i.e. those who are less expert in music) may differ, with even more considerable individual differences being recorded amongst musicians (Schon et al., 2000). However, it has not been firmly confirmed whether such differences manifest due to differences in individuals' musical training or due to inborn differences between individuals' cognitive abilities (Patel, 2007). Another example is left-handed individuals who seem to process speech by both of their hemispheres, whilst right-handed individuals seem to process speech predominantly by their left hemisphere (Kalat, op.cit.). Such arguments indicate that there may be considerable differences in the processing of speech, singing and music (Weber-Fox, 2001).

In relation to the above claims, atypical neural functioning may potentially be counter-acted by focussing on intact vocal behaviour, which may subsequently alter the functioning of other vocal behaviour through integrated neural networks (Belin and Zatorre, 2003; Zatorre, 2007). It should be noted that functions such as memories, attention and mental imagery are closely associated with the processing of auditory stimuli (Zatorre, op.cit.). Therefore, each individual is likely to process any auditory information in a unique way, based on their subjective experiences (Zatorre, 2007). Cognitive processes associated with auditory perception and any vocalisation are closely connected to motor control processes, further implying that variations can be recorded amongst individuals with regard to their final vocal products, which are results of these two functions (Patel, 2006). Furthermore, neural adaptation to repetitive vocal stimuli has been recorded in a number of individuals (Belin and Zatorre, op.cit.), providing further evidence for affecting neural change.

On the basis of the above claims, it becomes evident that neural functioning differs between individuals: the processes required for understanding and producing speech and those required for singing may be more closely interwoven in some individuals than in others. Based on such arguments, it may be possible to exploit intact neural processes underlying one vocal behaviour (such as singing) in facilitating other vocal behaviour (such as speaking) (Thurman, 2000). For instance, when a patient exhibits distorted speaking behviour, but intact singing ability, the patient's speaking behaviour may be improved by exploiting the intact neural networks responsible for their singing.

3.4.3 Processing of rhythm and pitch

The perception of rhythm is believed to be unique to human brain (Patel, 1998; Thaut, 2000). A wide range of cortical and sub-cortical networks underlie motor, sensory and cognitive aspects of rhythm processing, indicating that rhythm processing is associated with specific core functions of the human nervous system (Johnsrude et al., 2000). Simpler rhythms are processed in the left prefrontal and parietal brain areas, whilst more complex rhythms are processed in the right pre-frontal, pre-motor and parietal regions (Kuck et al., 2000).

The processing of pitch takes place in the planum temporale of the right hemisphere (Zatorre et al., 1994). Complex pitch processing takes place in the heschl´s gyrys in the left hemisphere, which is also associated with the analysis of the fundamental frequency of one's voice when retrieving feedback for the purpose of vocal monitoring (Perry et al., 1999). Such findings indicate that the processing of simpler rhythms may be more closely connected to the processing of speaking since such processing pre-dominantly takes place in the left hemisphere.

3.4.4 Connections between brain processes, emotional elements and vocal functioning

The sub-cortical structures that are required for rhythm perception, as well as for emotional arousal, may be closely related to speaking and singing abilities (Gardner, 1977). Such an argument is based on the fact that emotional influences of musical stimuli are recorded in a variety of brain areas and processes that are also likely to engage those concerned with speech and music (Welch, 2005). Therefore, any stimuli amounting to emotional arousal may influence the individual's speaking and singing ability.

The neural pathways needed for vocalisation and the pathways responsible for emotional processing overlap in the periquedductal gray (PAG) (Davis et al., 1993; Davis, 2005). Emotions are processed in the limbic system that consists of a number of neurological aspects (Davis, op.cit.). Any causal factor behind an individual's speech or voice disorder may influence the individual's neurological processes through its emotional impact (Baker, 2002b). For instance, when the original causal factor is of psychological nature, negative emotions may inhibit the functioning of neural pathways that are essential in vocalisation, resulting in distorted vocal sound (Baker, op.cit.; see Section 2.5.2 for more details). The individual's vocal output may, then, be enhanced by modifying their emotional state (Baker, 2002a; b; Nienkerke-Springer et al., 2006).

More specifically, Peretz and Coltheart (2003) proposed that the neural processing system required for comprehending music includes an emotional expression analysis component, which enables one to experience the emotional content of music. This particular neural component may potentially play a part in the processing of other emotional stimuli (Peretz and Coltheart, op.cit.), and it is often activated in individuals who have experienced psychological stress rather than in those not having experienced such stress (Baker, 2002a; b; Mathieson and Greene, 2003). Through stimulating this particular brain area with the use of singing, improvement in vocal functioning and voice quality may be achieved. This particular area of the brain is also involved in the processing of paralinguistic information in vocal stimuli (Zatore et al., 1994), providing further evidence for the integration of speaking and singing behaviours.

3.5 Connections between speaking and singing from the physiological perspective

Specific physiological structures are required for the generation of speech and singing (Sundberg, 1996) (see Chapter Two). These physiological mechanisms adapt themselves according to the vocal behaviour being generated (Sundberg, 2001). Specific mechanisms are more crucial in facilitating singing than speaking, yet the two vocal behaviours rely on the same physiological mechanisms (Bunch, 1997; Reid, 2001).

3.5.1 Specific components in the voice mechanism

In singing, the tension of vocal folds plays an essential role due to the fact that such tension is relative to the pitch and the intensity of the vocal product (Bunch, 1997; Rubin et al., 2003). The tension is also associated with the shaping of the vocal tract and the activity of the laryngeal muscles (Rubin et al., op.cit.). Such relations between tension and specific physiological components is not essential in speech production (Bunch, op.cit.), suggesting that there is a significant difference between the two vocal behaviours. Nevertheless, in all vocal behaviour, laryngeal muscles determine the length, tension and the vibration mass of the vocal folds during phonation as evidenced in laryngoscopic investigation (Reid, 2001; Rubin, 2005). Such studies provide evidence for the fact that particular physiological mechanisms underlie all vocal functioning.

In singing, muscle systems are required to change their balance of tension from one pitch to another with an extremely high speed, with the laryngeal muscles needing to be braced in order to be able to sustain the pitch or the intensity of the desired phonation (David, 1995). Singing is, therefore, a sensory-motor activity that requires specific, balanced physical skills (Bunch, 1997), whilst speaking does not require such refined skills (Mathieson and Greene, 2003; McAllister, 1997). However, all efficient vocal functioning relies on physical balance and knowledge of vocalisation (Rubin et al., 2003). Given that in singing such balance is always required, such skills may potentially be transferred to speaking through singing training (David, op.cit.). Moreover, functional differences can be recorded between professional singers and individuals who do not sing as much (Mathieson, 2000). For instance, singers' sub-glottal air pressure may be significantly higher and their vocal fold vibration cycle may be longer than those of non-singers, as a result of their extensive singing training (Mathieson, op.cit.). Therefore, singing training can alter overall vocal functioning.

Furthermore, particular exercises focussing on increasing or decreasing the amount of tension in the vocal folds can be used as a means to target most severe vocal distortions since such exercises often strengthen the vocal folds (David, 1995; Laukkanen et al., 2005). Moreover, spontaneous movements of the voice mechanism may be acted on in order for the mechanism to correct itself rapidly (Reid, 2001). Through focussing on adapting the use and functioning of the voice mechanism, distortions in both speech and singing can potentially be targeted (Rubin, 2005). Similarly, such claims provide support for the idea of speaking and singing being connected via the voice mechanism. Specific effects of singing training can be addresses and investigated comprehensive physiological examination, as indicated in the above studies.

The functioning of the voice mechanism is connected to different systems that control vocal functioning. Such systems constitute of three control functions: a) the pre-phonatory tuning system (i.e. mental formulation of the desired vocal output prior to expressing it); b) reflex modulation during phonation (i.e. matching of the vocal output with the desired model); and c) acoustic auto-monitoring (i.e. bone-vibrations and awareness of sound sensations in the vocal tract) (Wyke, 1976). When these functions are fully-operating, the individual should be able to speak and sing under any circumstances (Welch, 1985). Such functions may be facilitated through any vocal activities (such as singing) in order to affect change in the individual's vocal functioning.

It should be noted that the most important dynamical differences between speaking and singing are found in vowel sounds (Reid, 2001). More specifically, the functioning of the vowels in higher pitches is considerably different between speaking and singing behaviours (Bunch, 1997). The functioning of vowels in one vocal behaviour can potentially be applied to their functioning in other vocal behaviour in order to enhance an individual's overall vocal functioning.

3.5.2 Connections between speaking and singing behaviours though breathing patterns

Breathing patterns in singing differ slightly from those in speaking (Sundberg, 1996; Sundberg, 2001; Van der Wooljik and Karsten-Voets, 2007). Nevertheless, general trends in breathing can be recorded across vocal behaviours (David, 1995). There are three main types of respiration: a) calvicular breathing; b) costal breathing; and c) diaphragmatic breathing (David, op.cit.). All of these provide the individual with different degrees of energy for breathing. For example, costal breathing is relatively superficial, whilst diaphragmatic breathing provides an individual with a greater amount of energy (Rubin et al., 2003).

Without sufficient breath, one's speaking or singing may be inaudible due to a lack of energy (Bunch, 1997). Through singing activities, the child can be educated to exploit the diaphragmatic method since such a method provides more energy for voice production (Bunch, op.cit.).

Singing training, in particular, has been found to pose a facilitative effect on the individuals' respiratory functioning (Hixon and Hoit, 1999; Kopp, 1998; Mendes et al., 2006; Schneider and Bigenzahn, 2003; Virokannas, 1997). For example, the individual's speaking ability may be enhanced through applying breathing patterns used in singing to those used in speaking. In addition, when an individual's voice is not fully-functioning, the individual's lungs and diagraphm are likely to be functioning in low movements (Bunch, op.cit.). This may consequently influence the individual's speaking and singing behaviours negatively (Kopp, op.cit.).

Further evidence found for the connections between speaking and singing is from the notion that singing is an extension to speaking in the sense that it is a more sophisticated form of speaking (Kopp, op.cit.). The above claims indicate that all vocal output is interconnected via the breathing channel and, therefore, breathing can be the focus in holistic therapy settings in order to improve general vocal functioning and voice quality (Montello, 2002; Thurman and Welch, 2000) (see Section 3.4.2).

The basis for the above arguments is the idea that the entire body works on the power of breathing and that all disorders affecting the voice originate from an irregularity in respiratory functioning (Montello, op.cit.; Thomatis, 1987; Van der Wooljik, 2007). With specific reference to child clients, children need to use a greater amount of air pressure in order to be able to generate the magnitude of vocal sound that adults normally generate (White, 2001). Therefore, singing training could potentially be used in therapeutic settings as a means to improve children's general breathing patterns, subsequently resulting in greater airflow and further being reflected in improved vocal functioning and vocal output (Virokannas, 1997).

In summary, speaking and singing behaviours are interconnected through the physiological voice mechanisms that they share. Additionally, breathing is required in the production of all vocal sound and behaviours, indicating that speaking and singing behaviours share a common physiological root.

3.6 Connections between speaking and singing from the psychological perspective

Human body and mind are connected through complex neurological network s(Pert, 1986; Thurman and Welch, 2000) (see Section 3.5 above). Such a bodymind connection provides support for the inter-connections between speaking and singing behaviours since this bodmind entity is required in the production and processing of both vocal behaviours (Juslin and Sloboda, 2003; Montello, 2002; Seashore, 1967; Thurman and Welch, 2000; Tracy, 2006). The elements of the physiological body (i.e. the immune, endocrine and nervous systems) are affected by an individual's mental state and psychological well-being, which are reactive to the individual's physical well-being (Thurman and Welch, op.cit.; Stacy et al., 2002).

More specifically, Candice Pert (1986) invented the term 'bodymind'. Her claim was that our bodies and minds are inter-connected via neuropeptides and their receptors. Such neuropeptide-connections are found throughout the body (Thurman and Welch, 2000). Therefore, it is reasonable to talk about 'a bodymind' rather than an independent body and an independent mind (Pert, op.cit.). The processing of emotions, as well as any auditory stimuli, also takes place in such neurological networks (Pert, 1986; Welch, 2005). Such neurological process have been investigated through comprehensive and well-designed neurological and medical examination.

3.6.1 Holistic principles in voice therapy

Further evidence for the inter-connections between speaking and singing behaviours, voice, language, and music are found from studies exploring voice therapy strategies that advocate the use of holistic principles as their starting-point (Bunt, 2003; Butcher, 1993). For example, Montello (2002) focussed on the vibrating nature of the body in her therapeutic practice by using activities that aimed at balancing a client's bodily rhythms (such as their heart beat) in order to enhance the functioning of the client's autonomic nervous system. Alterations in the autonomic nervous system subsequently influences the centres of the brain that are responsible for processing emotions, further posing an impact on the individual's immune and endocrine systems (Montello, op.cit.). Such improvement in the individual's physical, as well as psychological, well-being is further connected to the individual's vocal functioning and voice quality in all vocal behaviour (Thurman and Welch, 2000).

Holistic principles are connected to the fact that sound consists of frequencies that vibrate in their own forms through our bodies (Rossi, 1997). As mentioned above, our nervous system and bodymind are shaped by the music and the sound environment we grow up in (Juslin and Sloboda, 2003; Rossi, op.cit.; Welch, 2005). Musical activities (in particular singing activities) hold significant and frequently facilitative functions on our bodyminds through their vibrating effect in our neural networks (Montello, 2002). Based on the reported positive impact that music has on our bodyminds, singing activities have been used in voice therapy settings as a complementary tool to the primary therapy strategies (Nordoff-Robbins, 1975; Rubin et al., 2003; Schalkwijk, 2000). However, new strategies have not been widely implemented to speech and voice therapy settings die to the fact that only little evidence exists on their effectiveness (Rinta, 2005).

3.6.2 Holistic and psychological factors in therapeutic settings

Different elements in the neurological networks significantly influence our holistic design. For instance, the amygdala is responsible for the processing of emotions, as well as for facilitating fundamental physiological functions (such as the heart rate and respiration) (Juslin and Sloboda, 2003). Within the amygdala region, positive emotions are pre-dominantly processed in the right hemisphere, whilst negative emotions are pre-dominantly processed in the left hemisphere (Bowers at el., 1993; Davidson, 1992). Such findings imply that, since music is primarily processed in the right hemisphere, it may be possible to influence an individual's emotional state through musical (including singing) activities. In particular, singing activities may be beneficial in improving the individual's voice production when the disorder originates from a psychological factor (Rubin et al., 2003). More specifically, activities focussing on stimulating particular brain parts are likely to influence the individual's neurological and psychological functions, in turn enhancing their vocal output.

Moreover, there are multiple emotional sub-systems in the brain that can be aroused through music (Juslin and Sloboda, 2003). For instance, individuals with speech or voice disorders originating from a psychological factor may be able to sing easier than to speak (Rubin et al., 2003) due to the fact that such individuals are often willing to express their emotions verbally, but the act is suppressed as a result of an emotional block (Bunch, 1997; Bunning, 2004). The influence of singing and music on the individual's bodymind enables the individual to relax, potentially releasing negative emotions and, consequently, enhancing their vocal functioning and vocal products. Moreover, the intimate relationship that we have with our voice when singing may prove to be extremely therapeutic, providing further evidence for the use of singing in therapeutic settings (Montello, 2002).

Furthermore, different musical elements possess their own influences on the clients' physiological body and psychological state (Peretz et al., 2004; Seashore, 1967; Sloboda, 2000). For example, the tempo of the music, the volume of the music and its dynamics can be manipulated in order to achieve desired effects in the client. Such elements can be exploited in therapeutic settings, for instance, in the form of singing activities in order to relax a client's bodymind and to enhance the client's vocal functioning (Seashore, op.cit.).

3.6.3 Psychological benefits of singing

Although both the body and the mind are influenced by music and singing, only a limited amount of research has been conducted on the psychological benefits of singing and such research have mainly concerned adults (Andrews, 1991; Beck et al., 2000; Bunch, 1997; Deem and Miller, 2000; Grape et al., 2003; Mendes et al., 2004; Silber, 2005; Stacy et al., 2002; Ternstrom, 2002; Thurman and Welch, 2000 Unwim et al., 2002; Valentine, 2001; Welch, 2005). One finding has been that singing performs an emotionally-expressive function (Baars and Gabrielsson, 1997; Baroni et al., 1997). Therefore, singing may be helpful in releasing negative emotions and, indirectly, in enhancing an individual's final vocal products (Bonet and Cason, 1993; Cross, 2002; Milutinovic, 1994; Welch, 2001). When an individual sings, the individual's emotions are manifested in their voice, body, face and brain, which are all further exploited in the production of singing (Baroni et al., op.cit.). Such claims indicate that singing may be an effective tool in releasing emotional tension, potentially leading to improved vocal functioning and vocal output.

The psychological impact of singing has been investigated with the use of different methods. A subset of the studies have focussed on the subjective feelings of the participants through anecdotal evidence in the form of interviews (Silber, 2005; Stacy et al., 2002; Unwim et al., 2002;), whilst other studies have concentrated on the connections between physiological and psychological sides through relying on a more medical investigation (Beck et al., 2000; Bunch, 1997; Deem and Miller, 2000; Grape et al., 2003; Mendes et al., 2004; Valentine, 2001). Specific psychological tests prior to and subsequent to singing activities have also been used for highlighting the psychological benefits gained from singing activities (Valentine, op.cit.). For instance, the Profile of Mood States-test was administered in one study prior to and subsequent to singing sessions in investigating the effect of singing on the participants' mood (Unwim et al., op.cit.). Different methods used in such studies are likely to generate information on different psychological functions of singing, consequently resulting in a comprehensive set of data on the benefits associated with singing. These studies have primarily gathered their data through interviews, questionnaires and post-pre-singing-session assessment via psychological tests.

More specifically, singing has been related to a number of functions, including those of psychological nature. More specifically, singing has been found to: possess mood-elevating properties; enhance general feelings of well-being; provide cognitive stimulation; and to improve social-interaction skills (Beck et al., 2000; Kenny and Faunce, 2004; Stacy et al., 2002; Unwin et al., 2002). Studies with amateur and professional singers, have provided evidence for such claims (Bailey and Davidson, 2005; Grape et al., 2003). Choral singing sessions, in particular, have been reported to have been linked to benefits from both psychological and physiological perspectives (Bailey and Davidson, op.cit.; Clift and Hancox, 2004; Silber, 2005). However, there have been no recorded difference in singers' psychological well-being when comparing choral-singing sessions to solo-singing sessions (Valentine and Evans, 2001), indicating that any type of singing activity may be of benefit for the individual's psychological state.

It should be noted that all of the above studies have been conducted with adults. Therefore, the findings are not necessarily directly applicable to children and such empirical data from children are needed to be collected. Nevertheless, the claims indicate that, singing may potentially hold positive influence on children at a psychological level.

3.6.4 Music, singing and holistic principles in therapeutic practice

Musical and singing activities can be modified according to a client's needs since music and singing can be exploited in therapeutic settings in several ways, depending on the origin of the client's speech or voice disorder and the music education that the client has received prior to commencing therapy. Physiological, psychological and sociological perspectives can all be focussed on in the therapy settings, either on their own or as complimentary one another (Hunt and Slater, 2003; Mathieson and Greene, 2003; Nienkerke-Springer et al., 2006).

With regard to a physiological approach, neural networks and the voice mechanism that are connected to the psychological side can be focussed on (Baker, 2002a; b; Hunt and Slater, 2003; Mathieson and Greene, 2003). In regard to a psychological approach, underlying psychological factors can be addressed in therapeutic settings. For example, when personal relationships are causing distress to a client and subsequently affecting the client's vocal output in a deteriorating way, singing activities taking place in pairs may be an appropriate intervention method for targeting the origins of the vocal distortion (Montello, 2002).

In regard to a sociological approach, sociological causal factors may be addressed through singing. For instance, group singing activities may be beneficial due to human tendency to socially-reinforce, implying that in group-settings individuals may learn from one another more effectively (Martin and Miller, 2003). Such a claim verifies the arguments that we develop an ability to respond to stimuli from our peers, as evidenced in studies specifically focussing on such social-enforcing factors through controlled-methods (Juslin and Sloboda, 2003; Sederholm and McAllister, 1997). In group settings, clients can model the therapist, the teacher and their peers in order to learn efficient voice use (Mathieson and Greene, 2003). Another way of exploiting group-singing is to focus on social behaviours and to encourage clients to express themselves verbally (Alvin, 1991). For child clients, musical and singing activities may be more beneficial than other therapy approaches for children since such approaches are generally perceived as fun and easy to engage in (Schwalkwijk, 2000).

3.7 Connections between speaking and singing in therapeutic practice

A number of different therapeutic strategies are currently used in speech and voice therapy practice, although (particularly with children) not a great deal of research has been conducted on effective speech and voice therapy tools (Bolfan-Stosic et al., 2002). Holistic factors have not been exposed to a great deal of research either (Rinta and Welch, 2008a).

Traditionally and most commonly, speech and voice therapists have either adopted a medical approach to their practice or an approach focussing on the physiological aspects of voice production (i.e. the voice mechanism) (Brumfit et al., 1988; Hemmarberg, 2000; Nienkerke-Springer et al., 2003; Speyer et al., 2003; Strand, 1995; Rubin et al., 2003). Both of the above methods inclusively focus on a client's speaking behaviour by modifying the client's vocal behaviour through a physiological approach without taking potential psychological or sociological factors into consideration (Hoffman-Ruddy, 2005; Nienkerke-Springer et al., op.cit.). However, these strategies may not be effective in treating all clients (Nienkerke-Springer et al., 2003; Kersner and Wright, 2002; Rubin et al., 2003; Thomasson, 2003). Consequently, alternative therapeutic approaches, have been and still need to be formulated. Nevertheless, there is a need for a greater variety of such strategies.

Furthermore, it should be noted that majority of new therapeutic strategies have been exposed to a limited amount of empirical investigation. Therefore, not enough evidence on their effectiveness exists (David, 1995; Rinta and Welch, 2008a; Rubin et al., 2003). Moreover, there clearly is a need for new strategies particularly within the child client population (Mathieson and Greene, 2003; Rubin et al., op.cit). Data are, in particular, needed from pre-and post-intervention studies in order to highlight specific benefits arising from the therapeutic method.

3.7.1 Traditional therapy methods

As mentioned above, traditional speech and voice therapy approaches either focus on the physiological side of the causal factors (such as a physiological disability) or on improving the functioning of the voice mechanism (Bunch, 1997; Rubin et al., 2003). Traditional approaches aim at improving the client's vocal functioning and voice production by focussing on the client's: breathing patterns; respiratory activity; method of vocal fold attack; and ability to co-ordinate different elements of the voice mechanism (David, 1995; Rubin et al., op.cit.; Welch and White, 1993; Wigram et al., 1995; Xu and Sun, 2002). The therapeutic strategies aim to educate the child client in producing healthy vocal sound with a minimal amount of effort (David, 1995; Longess, 2001; Rubin et al., 2003).

These strategies can be adapted to the individual client's needs and, at times, are combined with medication (Jackson-Menaldi et al., 2002). For example, when the original causal factor is a result of an allergic reaction, oral steroids have proven to be an effective form of treatment (Hogikyan et al., 2001). However, traditional strategies may ignore the actual origin of the distortion that may be of other than physiological nature (Butcher et al., 1987; Kopp, 1998; Laine et al., 1994; Nienkerke-Springer et al., 2003; Rubin et al., 2003) (see Chapter Two). For instance, the child client's vocal output may become distorted as a result of emotional distress (Nienkerke-Springer et al., op.cit.). Such arguments indicate that traditional strategies may not always be the most suitable approaches in treating a child client.

Strategies exploited in treating voice disorders may differ from those exploited in the treatment speech or singing disorders, although a great deal of the time all the approaches are interwoven (David, 1995; Laukkanen et al., 2005; Rubin et al., 2003). In fact, most significant improvement in a client's vocal functioning is often recorded when a speech and a voice therapist work as a team (Rubin et al., op.cit.).

The therapist can adopt either a direct or an indirect approach to their practice (Mathieson and Greene, 2003). Direct approaches focus on a client's vocal pitch, tone quality, volume used for speaking or breath-support that is essential for vocal functioning (David, 1995). Such activities enhance the client's breath control through the use of particular vocal exercises (Bunch, 1997). Indirect approaches, on the other hand, concentrate on the physiological elements that are associated with the client's vocal distortion (Rubin et al., 2003). Alternatively, a therapeutic strategy that focusses on the reduction of excessive vocal fold contact may be adopted, consequently leading to reduced muscular tension in the voice mechanism (Rubin et al., op.cit.).

3.7.2 Psychological factors and voice therapy strategies

In adults, voice production and vocal output is connected to psychological and personality factors (Alpert et al., 2001; Bunning, 2004; Butcher, 1993; de Cuyper, 2007; Hofmann, 2006; Miller and Schutte, 1990; Nienkerke-Springer et al., 2003) (see Chapter Two). The impact of psychological factors on children's vocal functioning and vocal products has also received support (Sandieser and Schneider, 2006; Sederholm, 1996). In particular, family relationships have been found to possess a significant influence on children's overall voice quality (Newham, 1993; Sederholm and McAllister, 2001). Therapeutic strategies focussing on the relationships within a child's family system may have a facilitative effect on the child's vocal functioning and final vocal products, as a result of improved intra-family communication and solved family conflict (Nienkerke et al., op.cit.; Sederholm and McAllister, op.cit.).

Individuals benefiting from psychologically-oriented therapeutic strategies usually have difficulties in expressing their negative feelings prior to commencing therapy, consequently manifested in the individual holding back their feelings and further having led to distorted overall vocal functioning and voice quality (at times, even voice loss) (Brumfit et al., 1988; Butcher et al., 1987; Sederholm, 1996). For example, the Prompt-approach that can be used in both speech and voice therapy places a great deal of importance on the psychological and sociological functioning of the individuals, as such functions are often impaired when an individual possesses a speech or a voice disorder (Prompt Institute, 2006).

The psychologically-oriented approaches primarily aim at enhancing the child's psychological well-being and secondarily at improving the child's vocal output (Baker, 2002a; b). For instance, when an emotional block is the original causal factor behind a child's distorted vocal output, the therapist will aim at releasing the block through facilitating the client's ability to express themselves emotionally, potentially leading to improved vocal functioning and healthier vocal products (Rubin et al., 2003; Schwalkwijk, 2000). Furthermore, music has been found to be effective when working with children suffering from emotional blocks, due to the positive influence of music on children's bodies and minds (Schwalkwijk, op.cit.; Thurman, 2000).

In the psychologically-oriented approach, speaking and singing behaviours can be focussed on through focussing on specific musical elements that can, consequently, modify the behaviours (Bunt, 2003). Moreover, singing and playing musical instruments can be used as a means to facilitate children's auditory perception and, subsequently, stimulate the children's vocal functioning (Batt-Rawden and Denora, 2005; Schwalkwijk, 2000). For instance, singing activities may improve a distorted speaking ability when the client's auditory abilities are trained (Bunt, op.cit.). The individual's perceptive, cognitive and expressive capacities are all in use when the individual is singing, indicating that such capacities may be influenced through singing

(Schwalkwijk, op.cit.). Improvement in such functions may, consequently, facilitate the individual's overall vocal functioning. Moreover, since singing focusses on the quality of the voice, singing activities may enhance an individual's distorted general voice quality (Welch and Howard, 2002).

3.7.3 The bodymind and therapeutic strategies

Holistic strategies that influence child clients' entire body have been adopted to practice by a number of therapists and teachers (Delamain and Spring, 2000; Mathieson and Greene, 2003; Thurman, 2000). Such strategies focus on the nervous, endocrine and immune systems through the use of music or singing (Mathieson and Greene, op.cit.; Montello, 2002). These strategies may release negative emotions (Delamain and Spring, op.cit.), as evidenced in the assumption that our cognitive, social and affective dimensions are interwoven within the complex bodymind (Thurman, op.cit.; Welch and White, 1993). Such approaches, therefore, indirectly enhance the client's vocal expression (Mathieson and Greene, 2003). Most human behaviour (including both speaking and singing behaviours) rely on complex operational systems that are associated to a number of physiological components (such as neural networks) (Peretz et al., 2004). Therefore, singing activities may facilitate positive actions in such components.

Relaxation strategies specifically focus on relaxing the voice mechanism and bringing the body into a desirable state by releasing any bodily tension that influences an individual's vocal functioning and final vocal products (Adams, 2001; Mathieson and Greene, 2003; Thurman, 2000). At times, these particular approaches are complemented with the use of medication in order to completely relax the client's body, consequently leading to enhanced vocal functioning as a result of improved motor-performance (Brumfit and Peake, 1988). The right hemisphere that is pre-dominantly responsible for the processing of singing may be exploited in improving client's speaking ability (Peretz et al., 2004).

With specific reference to voice therapy, states of relaxation are regarded as a crucial factor since excessive tension in any part of the physiological body can cause distortions in one's respiration, phonation and articulation (David, 1995). The majority of such strategies have focussed on relaxing the child client's throat, neck, shoulders and facial muscles (Rubin et al., 2003). With specific reference to speech therapy, Nielsen and Ramberg (1998) proposed that holistic strategies may be more beneficial for older children than for younger ones on the basis of unspecified reasons. Furthermore, Jacoby (1998) argued that holistic approaches may be more accessible to older children but they can also be used with younger children, although the children's understanding of such approaches may not be profound until a later age. A great number of such holistic strategies have been exploited in special and mainstream educational settings as opposed to specific speech and voice therapy settings, even though little evidence on their effectiveness exists (Kersner and Wright, 1997; Schwalkwijk, 2000).

3.7.4 Voice therapy and singing

A number of therapists have advocated the use of musical elements in their practice, with a number of teachers and therapists having supported the idea of focussing on rhythmic elements (Bunt, 2003; Daines et al., 1996; Flemming and Wright, 1997; Helfrich-Miller, 1994; Kersner and Wright, 1997.; Mendes et al., 2004; Moog, 1968; Schwalkwijk, 2000; Strand, 1995) since this particular musical element is regarded as a significant communicative factor in vocal expression (Moog, op.cit.). Rhythm, stress and intonation in musical passages may be paired with a linguistic component in order to facilitate motor movement and fluency in a client's speaking and singing behaviour (Chappell, 1995; Mathieson and Greene, 2003; Rubin et al., 2003; Strand, op.cit.; Tracy, 2006).

Furthermore, the coupling of rhythm with motor patterns has been found to be effective in voice education since such rhythmic activities may potentially lead to temporal integration in the brain, subsequently enhancing a client's vocal functioning and general vocal output (Long, 2004; Thaut, 2000.). Based on such arguments, it has been claimed that rhythm and speech processing are closely related to one another (Patel et al., 1997; Johnsrude et al., op.cit.). Furthermore, rhythmical activities can be exploited in manipulating the client's motor behaviour and neural responses in vocal tasks (such as speech production) (Chen et al., 2006).

In addition, rhythm may be used as a stimulus for vocal production through instructing the client to imitate the rhythmic passage (Chen et al., 2006; Cooper, 1973; Strand, 1995). Since children with distorted speech are often unable to perform rhythmic activities (Fletcher and Hall, 1992), rhyming games focussing on rhythm may be exploited in improving the child's fluency in speaking (Fletcher and Hall, op.cit.; Schwakwijk, 2000). Games that combine rhyming and clapping in song-form may also be effective (Hesketh and Adams, 2000). Rhythm can also be used as a means to manipulate a client's vocal output via modifying the client's motor behaviour and the neural responses in their auditory processing (Chen et al., op.cit.) (see Section 3.3 for more information).

In voice therapy, most efficient use of muscular function may be facilitated by co-ordinating muscle activity with rhythm (Mathieson and Greene, 2003). Phonic respiration (i.e. the ratio of the length of inspiration and the length of expiration in breath) may also be practised through exploiting musical stimuli (Hunt and Slater, 2003). Methods stressing and regulating the melodic line of verbal expression have received support (Helfrich-Miller, 1994; Hogikyan et al., 2001; Nordoff and Robbins, 1975; Square, 1994), based on the fact that young children imitate rhyming sentences and words most attentively (Helfrich-Miller, op.cit.). Through focussing on the melodic line of the vocal output, children's motor movements can be enhanced and the melodic intonations needed for expressive speech or singing can potentially be improved (Hogikyan et al., op.cit.).

Specific tongue strengthening exercises that focus on the melodic line of the vocal passage have often lead to efficient articulation (Lazarus et al., 2003). A specific melodic intonation strategy that has been constructed on three elements of vocal output (i.e. the melodic line, rhythm and the points of stress) has, at times, been adopted to use by both speech and voice therapists (Helfrich-Miller, 1994). In such activities, the rhythm and the stress of the vocal product are exaggerated, resulting in a vocal product that resembles chanting (Montello, 2002). Such a method has been found to be extremely effective with speech disordered children, although it cannot fully replace other therapeutic approaches and can be used as complementary tool (Helfrich-Miller, op.cit.).

Providing a client with cues that signal the correct place of articulation may be extremely useful in therapy (Square, 1994). In general, children are more able to exploit their voices in varied ways once cued (Bohnenkamp et al., 2002). Such cues may be of auditory, tactile or kinaesthetic natures (Kersner and Wright, 2002; McAllister, 2002; Square, op.cit.). For example, musical auditory stimulus may be used as a tool to facilitate the melodic line or the rhythm of spoken or sung vocal product (Square, 1994). Cues may also be used for achieving efficient articulatory functioning (McAllister, op.cit.). Moreover, Kersner and Wright (op.cit.) emphasised the importance of educating children in the awareness of surrounding sounds and their own voice, with specific emphasis being placed on listening exercises in early years, based on the fact that auditory skills are crucial for developing children's vocal abilities.

It can be argued that efficient listening skills play a considerable role in the production of 'normal' and healthy vocal output (Ball, 1991; Cooke and Williams, 1991; Oster et al., 2002; Thurman, 2001). For instance, children can be encouraged to imitate a therapist or a teacher through intensified auditory perception, subsequently leading to enhanced voice production (Zetterholm, 2002). Moreover, learning to listen to one's own voice may be one of the most important factor in improving one's voice production (Mitchell, 1991). Furthermore, Schwalkwijk (2000) argued that children should be exposed to auditory stimuli on a regular basis in order to educate them in attending to sound in order to build ground for imitative activities. Williamson (1995) stressed the importance of musical activities in enhancing children's ability to differentiate between various musical sounds and rhythms, based on the idea that improved listening skills lead to enhanced speaking and singing abilities.

Auditory approaches may also be used when attempting to capture a child's attention (Kersner and Wright, 2002). However, with children who possessed a hearing impairment, activities engaging the child's auditory functioning may not be suitable, despite the fact that both temporal and spectral information in speech may be exploited by each individual and the fact that deaf individuals demonstrate sensitivity to such features (Oster, 2002.). In fact, Kopp (1998) argued that singing activities as a complementary approach to voice therapy may be extremely effective with both hearing and deaf children since singing as a holistic tool can be used in influencing the whole person (such as their physiological and psychological functions) (Rubin et al., 2003).

Finally, it should be noted that only a few studies have investigated the effectiveness of new, alternative therapeutic approaches. This fact is the main reason for why such approaches are not widely exploited by speech and voice therapists or special educational needs teachers in their practice (Rinta, 2005; Rubin et al., 2003). Theoretical rational and sufficient empirical evidence are needed in order for such strategies to be implemented in practice (Law, 1997).

Furthermore, when formulating new strategies, it should be noted that the experience of treatment should be pleasant for the child client. Children are often unaware of their vocal disorders, and it is extremely important to keep the child motivated and interested in the therapeutic activities in order to receive maximum benefit from the intervention (Nienkerke-Springer et al., 2003). Therefore, singing activities may potentially be an effective approach with children, based on their pleasant nature. They may provide an alternative focus and context for therapy settings in comparison to traditional speech and voice therapy strategies (see Figure 3.1). Nevertheless, empirical evidence on the effectiveness and benefits of singing in such therapeutic settings in needed.

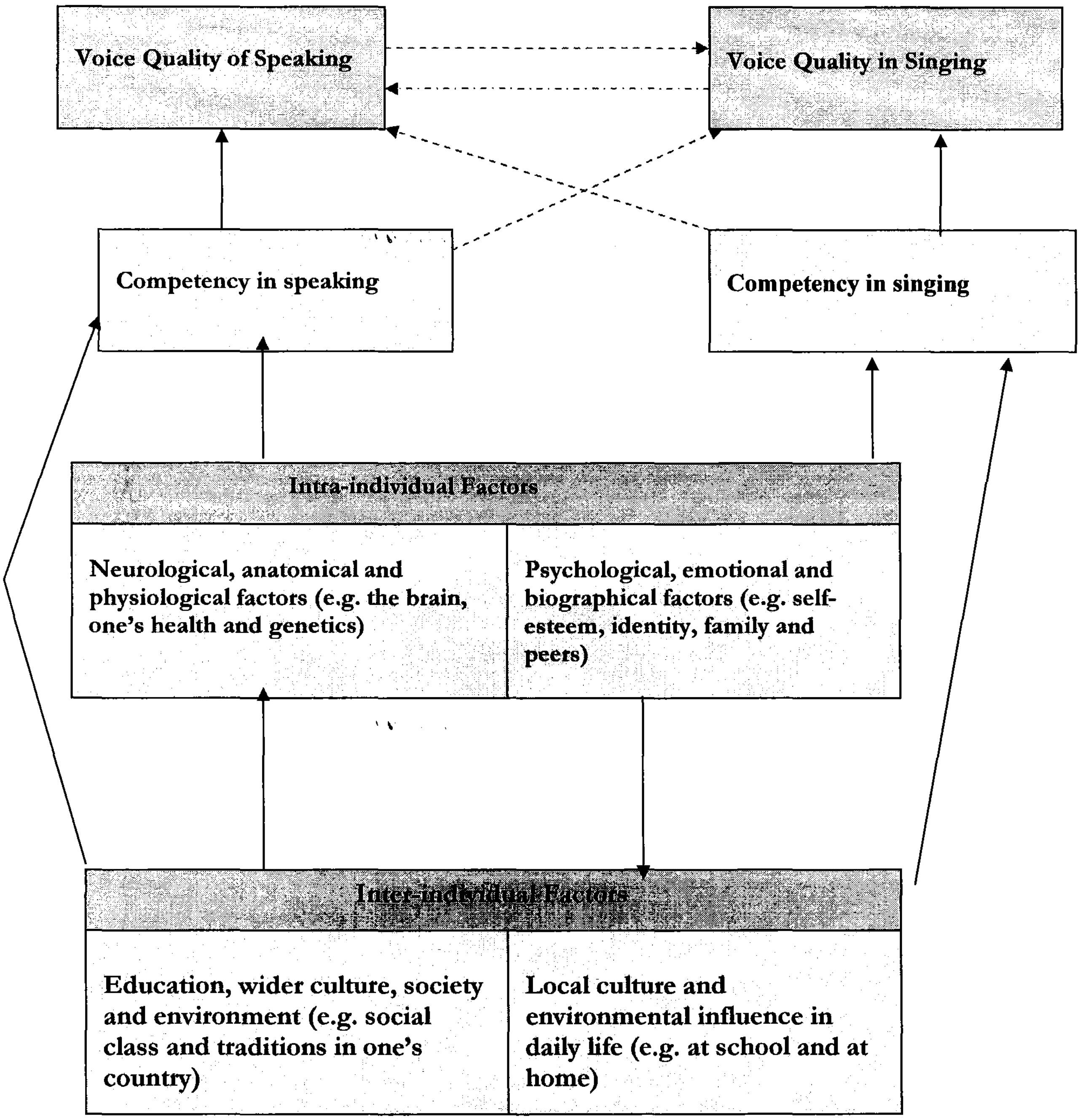


Figure 3.1: The model demonstrates how different factors possibly interact and influence each other. Various intra- and inter- individual factors are theorised to influence one another and shape individuals' overall vocal functioning and voice quality in addition to the perceived levels of speaking and singing competency. Individuals' levels of speaking and singing competency influence the quality of the vocal output, both in speaking and singing. The research focus for the current study is exploring how the perceived quality of voice when speaking is connected to the quality of voice when singing (and vice versa). The research questions are highlighted with red arrows in the figure.

3.8 Implications for the current study

As discussed above, children's vocal products have been shaped and continuously influenced by a number of physiological, psychological and sociological factors. These factors also shape and influence the processing of musical elements, language and any auditory stimuli that children are exposed to. In addition, children's speaking and singing behaviours are connected via such factors. The discussion indicates that singing may potentially effect change in children's speaking behaviour (and vice versa). Therefore, the intention of the study was to investigate the possible connections between speaking and singing behaviours, as well as 'speaking' and 'singing' voices. The research questions were:

- Are the two vocal behaviours (i.e. speaking and singing) connected from the physiological, psychological, developmental and sociological perspectives?

- Can change be effected in one vocal behaviour (e.g. speaking) through the other vocal behaviour (e.g. singing)?

- Are children's 'speaking' and 'singing voices connected?

Chapter 4: Potential inclusion of singing in perceptual voice assessment with pre-pubertal children

4.1 Introduction

In the current study, perceptual voice assessment was the prime tool used for determining: whether there were perceptual similarities or differences between the participant children's speaking and singing behaviours; and whether the participant children's vocal functioning and voice quality were perceived to be as 'normal' or 'abnormal' with reference to the participants' speaking and singing behaviours. This Chapter focuses on perceptual voice assessment, but it also includes a section for acoustic analyses in order to highlight the differences between the two types of assessment approaches and to justify the use of perceptual voice assessment as the primary assessment tool in the current study.

4.2 Purposes of voice assessment

In order to determine whether a child's vocal functioning and voice quality can be classified as 'normal' and healthy or as 'abnormal' and unhealthy, a variety of aspects in vocal functioning need to be assessed. In speech and voice therapy practice, voice assessment is performed by the therapist once a child has been referred to their practice, most often subsequent to a parent or teacher having become concerned with the child's speaking behaviour (Hunt and Slater, 2003). Occasionally, it is the child him/ herself who has become aware of their distorted speaking ability in daily communication once an 'abnormality' in their speaking behaviour has started to disturb the child (Mathieson and Greene, 2003).

In voice assessment setting, the aims of voice assessment are to: diagnose any distortions in a child's vocal functioning and voice quality; formulate a profile for the 'abnormality' of a child's voice when the child is perceived as possessing a speech or voice disorder; assess the degree of the child's vocal distortions; and determine the prognosis of the disorder (Hirano, 1989). In the assessment process, it is essential to formulate a comprehensive, detailed profile of a child's vocal functioning in order to be able to identify the type of speech or voice therapy programme that may be most beneficial for the child (Deem and Miller, 2000). In addition, the original causal and contributing factors behind the disorder need to be assessed (Mathieson and Greene, 2003; Hunt and Slater, 2003). The act of identifying any causal and contributing factors may prove to be a challenge to the professional due to the fact that children's voice disorders may have diverse origins (Baker, 2002a; b; Hunt and Slater, op.cit.; Mathieson and Greene, op.cit.; Thurman and Welch, 2000) (see Chapter Two). Nevertheless, any of such factors need to be addressed in order for subsequent therapeutic intervention to be effective (Nienkerke-Springer, 2003; Williamson, 1995). For example, any physiological underlying factors need to be address through a thorough physiological examination and potential psychological causal factors need to be assessed with the use of psychological tests (Baker, op.cit.).

Voice assessment often relies on the process of evaluating various voice parameters from both live and recorded voice samples (Amir et al., 2004; McAllister, 1997; Sederholm, 1996; Wilson, 1987). Examples of such voice parameters are hoarseness and nasality (Sederholm, op.cit.). Each chosen parameter is assessed separately either through perceptual voice assessment or acoustic analyses (Andrews, 1991; Mathieson and Greene, 2003; Sundberg, 2001). However, such assessment process is complicated by the fact that ambiguities remain as to exact and precise definitions for each voice parameter (Amir et al., op.cit.) (see Chapter Two). The general and overall quality of one's voice is the combined result of the ratings provided for the separate voice parameters (Kreiman and Gerratt, 2000). More specifically, specific voice parameters construct the different vocal aspects and elements that contribute to the general impression of a child's voice (Bolfacn-Stosic et al., 1998; Wilson, 1987). Perceptual assessment allows one to assess the overall quality of a child's vocal functioning and voice quality relatively comprehensively.

In the current study, the purposes of voice assessment were to: assess the participant children's vocal functioning in their speaking and singing behaviours; assess the quality of the children's voices in their speaking and singing behaviours; highlight any perceptual similarities and differences between the participant children's speaking and singing behaviours; and investigate 'normal' and 'abnormal' characteristics in the children's vocal functioning and voice quality in both vocal behaviours.

4.3 Voice samples and assessment approaches in voice assessment

The use of voice samples purely consisting of vowels or those consisting of a combination of vowels and consonants in voice assessment as the prime source of information has been debated (Bassich and Ludlow, 1986; Murdoch et al., 2002; Tanner et al., 2004; Sederholm, 1996). Since vowels and consonants are perceived as different sounds and are produced by different articulatory mechanisms, considering both vocal sounds in the assessment process may be of benefit (Bassich and Ludlow, op.cit.). It is fairly common practice to include both continuous speech and sustained vowels in the assessment process in order to gain a comprehensive and accurate voice profile for the child client (Hunt and Slater, 2003; Ma and Yiu, 2005; Sederholm, op.cit.). Such practice is based on the fact that noticeable differences in general voice quality can be recorded when comparing connected speech to sustained vowels (Sederholm, 1996). For instance, Tanner and his colleagues (op.cit.) proposed that a voice sample consisting of both continuous speech including both vowels and consonants should be the primary source of information since vowels are not always affected by vocal distortions and, therefore, may not provide a reliable profile of a child's vocal functioning and voice quality.

Furthermore, it has been claimed that voice assessment should focus on a child client's habitual pitch (Altman et al., 2005). Such an argument is based on the fact that distortions in habitual pitch constitute the main characteristic of a significant number of voice distortions (Altman et al, op.cit.). Therefore, focussing on this element may be a beneficial starting-point for diagnosing any distortions in a child client's vocal functioning or voice quality. The voice tasks included in the assessment process may be modified to target specific vocal feature (such as resonance or the child's breathing habits). For example, consonants may be a useful source for diagnosing hypernasality, whilst a reading test may be beneficial in diagnosing general speech disfluency (Wilson, 1987). It should be noted that, although singing tasks have not generally been included in the assessment process, such tasks may highlight additional aspects of children's vocal functioning and voice quality (Rinta and Welch, 2008a).

The voice tasks selected for the assessment process should be natural and easy for the child to engage in in order for the assessment outcome to be reliable (Andrews, 1991). A combination of voice tasks that as a whole cover the primary aspects of children's voice production process is likely to be a reliable way of gathering voice data from children, provided that the practitioner has the time and resources for conducting a thorough assessment process (Mathieson and Greene, 2003; McAllister, 1997; Speyer, 2007; Wilson, 1987). For instance, a reading task in combination with a task consisting of sustained vowels and a simple singing task are likely to provide the therapists with a comprehensive vocal profile for the child's vocal functioning and voice quality (Andrews, op.cit.; Hunt and Slater, 2003; Wilson, op.cit.). Most commonly, speaking and reading tasks, as well as tasks focussing on sustained vowels, are relied on the assessment setting (Andrews, 1991; Hunt and Slater, op.cit.; Mathieson and Greene, op.cit.; McAllister, po.cit; Sederholm, 1996; Wilson, op.cit.).

With regard to methods used in voice assessment, the most commonly adopted approaches are: perceptual voice assessment and acoustic voice analyses (McAllister, 1997; Sederholm, 1996; Sundberg, 2001). These two assessment methods are distinct from one another, as discussed below.

4.3.1 Perceptual voice assessment

Perceptual voice assessment forms an essential part of voice assessment practice (Bolfan-Stosic et al, 1998; Carding et al., 2000; Hunt and Slater, 2003; Kent, 2000). Most often, perceptual voice assessment can be used as a means to constructs the basic profile for a client's vocal profile by identifying any initial voice distortions (Carding et al., op.cit.; Yamaguchi et al., 2003). Such assessment is conducted with the use of recorded and live voice samples (Hirano, 1989) (see Section 4.3). An additional function of perceptual voice assessment is to validate findings from acoustic voice analyses or other instrumental assessment procedures (Kreiman and Gerratt, 2000) (see Section 4.3.2).

Perceptual voice assessment process is often relied on since acoustical voice analysis is not always feasible due to its technological requirements (Kent, 2000) (see Section 4.3.2). Furthermore, perceptual voice assessment is regarded a valid tool in providing the therapist with a general yet comprehensive impression of a client's vocal functioning or voice quality (Hunt and Salter, op.cit.). By listening to a client's voice, one can detect any major (and even minor) distortions in the client's vocal functioning and voice quality (Mathieson and Greene, 2003).

When assessing a child client's vocal functioning and voice quality, most often the therapist relies on a perceptual voice assessment protocol (Carding et al., 2000). Such protocols measure the client's vocal output on the basis of a formally standardised voice profile (Carding et al., op.cit.; Hirano, 1989; Hunt and Salter, 2003; Moerman et al., 2007; Wilson, 1987). These protocols are relatively short and compact, most often one page long, accompanied by a set of instructions as to how to use the protocol (Carding et al., 2000). Each protocol contains pre-set categories for separate voice parameters and speech components (Yamaguchi et al., 2003) (see Appendices for detailed descriptions on the protocols). These protocols are used as a reference-point during the assessment process and the outcome of the assessment process is based on the therapist's perceptual skills (i.e. listening and observing) (Marshall et al., 2006; Yamaguchi et al., op.cit.). More specifically, the therapist is instructed to listen to the client's speaking behaviour and to fill in the protocol on the basis of his/ her perception of the client's vocal output (Carding et al., op.cit.; Chan and Yiu, 2006).

Each perceptual voice assessment protocol consist of boxes, categories or continuous lines that perform as the rating scale (Carding et al., 2000; Yamaguchi et al., 2003). Each voice parameter has its own section in the protocol and the ratings for each one are completed by ticking a suitable place on the scale, on the basis of the therapist's perception of the voice sample (Yamaguchi et al., op.cit.). For example, when a therapist perceives the voice as possessing an excessively rough quality, (s)he indicates this in the protocol by placing a mark at a point on the scale that indicate severe roughness (Yamaguchi et al., 2003).

A major challenge that therapists face in perceptual voice assessment is the interpretation of the complex acoustic features of the voice in a reliable and comprehensive way (Carding et al., 2000; Chan and Yiu, 2006). In order to formulate a reliable vocal profile for the child client, a variety of voice tasks need to be exploited (Hunt and Salter, 2003; Mathieson and Greene, 2003). For instance, Ma and Yiu (2005) stated that perceptual assessment is a valid measure once specific tasks (such as those including a sustained /a/ sound) are administered to the client. Furthermore, therapists may not have been trained to use perceptual voice assessment protocols in their practice. Such a claim poses doubt on whether perceptual voice assessment is a reliable assessment tool (Behman, 2004) (See Section 4.5 for a detailed discussion).

4.3.2 Acoustic voice analyses

Despite the fact that perceptual voice assessment is most common practice amongst therapists (Hirano, 1989; Vieira et al., 2002; White, 1997; 1998), it has been argued that acoustic analyses may be a more reliable assessment method since it is less subjective and less reliant on an individual therapist's listening skills (Pounchoulin et al., 2007; Tanner et al., 2004). On the basis of such claims, perceptual voice assessment is often accompanied by acoustic voice analyses (Eadie and Doyle, 2005).

Acoustic analysis relies on voice data that has been recorded with high-quality equipment in order to capture the needed detail from the client's voice data (Sundberg, 1987). Subsequent to the recording, the voice data are downloaded and analysed with the use of specific computer programmes. Examples of such analyses programmes are Praat, WinSingad and the phonetogram (Howard, 1997) (see Figure 3.1). Each voice parameter is represented in the computer programme in their characteristic form (Sundberg, 2001). The programmes separate different signals from the voice data into segments. For example, the fundamental frequency of a client's voice is demonstrated through the vertical position of the signal on the computer screen, with low position implying low fundamental frequency and high position indicating high fundamental frequency (Sundberg, op.cit.) (see Figure 4.1).

Acoustic analyses generate information on voice distortions in a fairly straightforward way, based on the acoustic signals that provide potential implications of any pathological elements in the voice (Drennan and Watson, 2001a; b; McAllister, 1997). However, external matter may bias the outcomes of such an assessment process. For instance, temporary excess mucosa may cause the acoustic signal to suggest a voice disorder when the client does not possess any obvious vocal distortion (Sederholm, 1996). Such interferences decrease the reliability of acoustic analyses. In fact, it has been argued that acoustic measures are to be inconsistent predictors of voice quality, based on insufficient evidence on their validity (Shrivastav and Deliyski, 2007).

Since acoustic analyses may ambiguously detect voice distortions, the results from this type of analyses may not always match with the outcomes from perceptual voice assessment (Kreiman and Gerratt, 2000; Pabon et al., 2000). Furthermore, external factors (such as the software systems used or intra-subject variability in ratings) have been found to be significantly influential on the therapist's judgement on the outcome from the acoustic analyses process (Deliyski et al., 2006). Such arguments provide evidence for relying on perceptual voice assessment in gathering eliable assessment outcome (Mathieson, 2000). Moreover, a number of therapists do not possess the financial status for purchasing the technological programmes needed for acoustic 80

analyses, nor do they have the time to conduct such analyses with each individual client (Drennan and Watson, 2001a).

DIAGRAM SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

Figure 4.1: Output from an acoustic analyses programme called the phonetogram (adopted form http://www.drspeech.com/Phonetogram

4.4 Different perceptual voice assessment protocols

There are a number of formally-established voice assessment protocols, but the validity and reliability of such protocols have not been investigated extensively (Carding et al., 2000) In the UK, the most commonly used formally-established perceptual voice assessment protocols are: the GRBAS-Scale, the Buffalo III Voice Profile and the Vocal Profile Analysis (VPA) (Carding et al., 2000) (See Appendices for detailed descriptions on the full protocols). It may be that these protocols have been adopted to professional practice due to the fact that no other reliable and valid protocols have been developed for such a purpose.

The GRBAS-scale is the minimum requirement for practicing professionals in the UK (Carding et al., 2000; Mathieson and Greene, 2003). This particular protocol consists of a four-point rating scale (Mathieson and Greene, op.cit.). The protocol includes five voice elements: overall severity of the client's speech or voice distortion; roughness of a client's voice; breathiness of a client's voice; asthenesia of a client's voice; and strain in a client's voice production (Carding et al., op.cit.). The nature of the rating scale is a continuous line that can be divided into four categories when evaluating the assessment outcome (Laver, 1968). It has been claimed that the GRBAS-scale represents the basic vocal dimensions comprehensively that we primarily pay attention to when listening to vocal sound (Velsvik Bele, 2004).

The Buffalo III Voice Profile uses a five-point interval scale that ranges from 'normal' to 'very severe abnormality' (Wilson, 1987). The nature of the rating scale is continuous lines and category numbers that are visible on top of the line (see Figure 4.2). It consists of categories for twelve major vocal elements by providing pre-set definitions for each one (Yamaguchi et al., 2003). The protocol is accompanied by ten distinct voice profiles, each of which focusses on a different physiological or psychological aspect associated with voice disorders (such as voice abuse or feeling of anxiousness) (Wilson, op.cit.).

The Vocal Profile Analysis consists of: five general vocal features, nine voice quality features and three prosodic features (Schewell, 1998). Such features significantly contribute to characteristic voice quality (Freeman, 2000; Freeman and Fawceus, 2000; Schewell, op.cit.). The nature of the scale is a nominal scale covering six points in the form of a continuous line (Freeman, op.cit.). Each voice parameter is assessed with reference to a neutral point on the scale (Freeman, op.cit.; Laver, 1968). When using this particular perceptual voice assessment protocol, comparisons are made between a therapist's ratings for particular voice samples and a pre-defined neutral baseline that indicates what characteristics can be perceived as 'normal' or as 'abnormal' in a child client's voice (Carding et al., 2000).

82

Loudness Too Loud Too Soft	**Normal** **Mild** **Moderate** **Severe** **Very severe** **1** **2** **3** **4** **5**
Laryngeal tone Breathy Harsh Hoarse	**Normal** **Mild** **Moderate** **Severe** **Very severe** **1** **2** **3** **4** **5**

Figure 4.2: Two items from the Buffalo III Voice Profile as examples of this particular assessment protocol

Five-point or seven-point equal-appearing interval scales are frequently used as the rating scales in the perceptual voice assessment protocols (Sederholm, 1996). However, the limited number of categories in such scales may divide the voice data into too few categories, potentially resulting in a loss of informative voice data (Fiske, 1994; Freeman, 2000; McNeill et al., 2007; Sederholm et al., 1993). On the basis of such arguments, Sederholm (op.cit.) claimed that a protocol that has been constructed on continuous lines is a more reliable tool in assessing 'the normality' or 'the abnormality' of a voice sample. Such an argument is based on the fact that a scale that consists of continuous lines is not constructed on any intervals and allows a therapist to perform the assessment task without any quantitative terms or scaling –points (Sederholm, 1996; McAllister, 1997) (see Figure 4.3). McAllister (op.cit.) supported the use of such scales by arguing that such a rating scale is efficient in differentiating between perceived 'normal' and 'abnormal' vocal products.

	Absence of		Severe degree of
Nasal		____________________	
Hyperfunctional		____________________	
Hyponasal		____________________	

Figure 4.3: Three items from the Visual Analogue Scale as example of this particular perceptual voice assessment protocol

It should be noted that all of the formally-established perceptual voice assessment protocols have been formulated primarily for assessing speech samples as their prime source of information (Wilson, 1987). For instance, the VPA focuses on the client's laryngeal and supra-laryngeal functioning and the prosodic aspects of a client's speech (Carding et al., 2000), whilst the Buffalo III Voice Profile focuses on vocal pitch, loudness, resonance and laryngeal tone (Wilson, 1987).

4.5 Reliability of perceptual voice assessment

A complication with formally established perceptual voice assessment protocols is that each of them relies on different descriptive terms when defining individual voice parameters (Carding et al., 2000; Yamaguchi et al., 2003). Such definitional differences may result in variation between assessment outcomes (Yamaguchi et al., op.cit.). A further complication is that different practitioners have focussed on different aspects of voice production when attempting to define individual voice parameters (Carding et al., op.cit.). For example, hyperfunction has been defined as strained vocal sound by Velsvik Bele (2005), yet as excessive use of muscular force by Wilson (1987). As a result of such ambiguities, it may be extremely difficult for professionals to discuss the outcomes of their assessment when they have relied on different assessment protocols (Yamaguchi et al., 2003). It may also be difficult to match physiological, acoustic and aerodynamic correlates with perceptual measures due to such ambiguities in the definitions for individual voice parameters (Kreiman and Gerratt, 2000).

Inter-rater reliability is a crucial aspect of determining whether a perceptual voice assessment protocol is a reliable assessment instrument (Anders et al., 1988; Carding et al., 2000; Kreiman and Gerratt, 1998; 2000; Kreiman et al., 1992; Lewison and Carding, 2003; Lindsay et al., 2002; McCrory, 2001; McFarlane et al., 1991; Shrivaskov and Sapienza, 2003; Zraick et al., 2004). The studies of inter-rater reliability have yielded conflicting results. For example, differences in assessment outcomes have been recorded between professionals located in different countries (Kreiman et al., op.cit.). More specifically, humans are not always consistent in conducting comparative evaluations (such as when comparing a voice sample to its neutral baseline), further interfering with the outcome when calculating inter-judge reliability (Fiske, 1994).

Furthermore, inter-judge reliability may differ from voice parameter to voice parameter (Yamaguchi et al., 2003). Yamaguchi and his colleagues (2003) found considerable differences between assessment outcomes derived from Japanese professionals and those from their American peers as to their ratings of specific voice parameters (such a hoarseness) but not of others (such as breathiness). Additionally, Anders and his colleagues (1988) found differences between European and American professionals' assessment outcomes. Such differences may derive from the fact that voice assessment is language and culture-specific, with its semantic terms varying a great deal between languages and perceived cultural appropriateness of vocal sounds differing between cultures (Bassich and Ludlow, 1986; Sederholm, 1996). For example, a voice may be perceived as excessively nasal in France but not in Japan (Bassich and Ludlow, op.cit.), or the semantic terms in different languages may imply different voice qualities (Anders et al. op.cit.).

Moreover, an individual's articulation mechanisms differ according to the individual's mother-tongue, implying that 'normal' vocal characteristics may differ between speakers of different languages as a consequence of such articulatory differences (Scharff-Rethfeld and Miller, 2006). For instance, variation in the 'normal' fundamental frequency of a person's voice has been recorded between mono- and bilinguals, providing evidence for such articulatory differences (Scharff-Rethfeld and Miller, op.cit.).

Furthermore, significant differences in assessment outcomes have been recorded between those derived from practicing speech and voice therapy professionals and those derived from naïve listeners (Kreiman et al., 1992). Additionally, greater differences in assessment outcomes have been found between two professionals than between two naive listeners (Kreiman et al., op.cit.). The reason for such a finding may be that listeners' background (such as the type of training they have received or their client population whilst training) influences the strategy that they use when performing the voice assessment tasks (Kreiman et al., 1998). For example, naïve listeners tend to rely on specific vocal features with all clients and with any voice sample, whilst professionals tend to vary their assessment strategies according to their client (Behman, 2004).

Judgement on perceived 'normality' or 'abnormality' of the voice is constructed on the basis of the listener's previous experiences, which have resulted in a standardised ability to assess a client's voice (Velsvik-Bele, 2004). Shrivastav (2005) argued that the differences recorded in the assessment outcomes between individual listeners may be the results of different interfering factors (such as the perceived noise in the voice signal of recorded samples). It was further argued that a proper experimental design in perceptual studies could diminish the great inter-subject differences found in previous studies (Shrivastav, op.cit.). Chan and Yiu (2006) also claimed that, once professionals have been trained to assess the voice with the use of recorded voice-samples, the reliability of the perceptual voice assessment process may be increased. The therapists should also be instructed to perform the assessment task in a pre-defined manner and instructions should be provided as to which type of settings the assessment should be conducted in (Carding et al., 2000). For instance, therapists could be instructed follow the instructions accompanying the assessment protocol (See Section 4.10). Such practice is even more important due to the fact that the environment in which voice assessment is carried out has an impact on the assessment outcome and that the clinical settings in different countries may vary between countries (Vastjall, 2004).

As mentioned above, one major complication in voice assessment is that there are no formally established definitions for 'normal' or 'abnormal' voice quality and for specific voice parameters, suggesting that each professional possesses their own idea of such elements (Bolfan-Stosic et al., 2003; Sederholm, 1996) (see Chapter Two). Therefore, perceptual voice assessment may be extremely subjective and dependent on the professionals' training and prior professional and personal experience and background (Carding et al., 2000). On the basis of such arguments, Kreiman and Gerratt (2000) claimed that perceptual voice assessment methods should leave space for individual variation. There may be greater variation amongst ratings provided for specific voice parameters than those provided for other parameters (Hammarberg, 1987). For example, strain, vocal stability and breathiness are basic elements of the majority of perceptual voice assessment protocols, with such parameters being generally judged reliably (Hammarberg, op.cit.).

Nevertheless, it has been argued that we all possess perceptual conceptions of 'normality' and 'abnormality' in general vocal functioning and voice quality (Freeman and Fawceus, 2000; Hammarberg, 1987; McAllister, 1997). For example, Sederholm and McAllister (2001) claimed that, despite our individual experiences and subjective views, inter-rater reliability is found to be relatively high amongst listeners. The arguments imply that we have an ability to distinguish between 'normal' and 'abnormal' voices even without extensive training, as long as space is left for individual variation. More specifically, stimuli from our environment shape our perceptions on what can be regarded 'normal' and what 'abnormal' in our voices, resulting in standardised perceptions of vocal sound

The reliability of perceptual voice assessment may potentially be increased by relying on more than one assessment protocol during the assessment process (Wilson, 1987). Moreover, since our vocal functioning is multidimensional in nature (Hillenbrand, 1994; Kent and Ball, 2000; Welch, 2005) (see Chapter One), professionals should not solely rely on one perceptual voice assessment approach in their practice. Rather, professionals should include complimentary elements from at least two protocols in order to gain a comprehensive, reliable profile of the client's vocal functioning and voice quality (Çerratt, 2001; Mathieson and Greene, 2003; Solberg, 1994; Speyer, 2004). Perceptual voice assessment should ideally be supplemented by another form of assessment (such as a physiological examination) in order to address all potential causal and contributing factors behind a client's vocal distortion (Hernando et al., 2003; Hunt and Slater, 2003; Kazi et al., 2007).

4.6 Assessing the child voice

The need for perceptual voice assessment protocols specifically designed for assessing the child voice has been undermined due to the fact that it is generally believed that children's speech and voice disorders will diminish as the children grow older (Baker, 2002a). Assessing the child voice may possess great challenge to professionals (Andrews, 1991; Wilson, 1987). The challenge is to conduct a comprehensive assessment process despite the lack of normative data on children's vocal behaviours and products (Hirano, 1989; White, 1993, 1997; Whiteside, 2001; Whiteside and Hodgson, 1999).

Moreover, the reference point for 'normality' changes alongside the children's physiological maturing process (Welch and Howard, 2002). The process is further complicated by the fact that there are no formally-established definitions for parameters that constitute the child voice (Leith and Johnson, 1996; Sederholm, 1996; Wyots et al., 2001). Nevertheless, the child voice should be assessed in its own terms and not in comparison to the adult voice since it differs significantly from the latter (White, 2001) (see Chapter One). For instance, the child voice is characterised by a distinct degree of breathiness, hyperfunction and roughness (Hunt and Slater, 2003; McAllister, 1997; Sederholm, op.cit.). The child voice also possesses a less dynamic vocal range than the adult voice (Hunt and Slater, op.cit.).

Despite the fact that the child voice significantly differs from the adult voice, a limited number of perceptual voice assessment protocols specially formulated for assessing the child voice exist. A subset of therapists use the Buffalo III Voice Profile (Wilson, 1987), a number of therapists use the same perceptual voice assessment protocols with child clients as they do with adult clients (Rinta, 2005). Nevertheless due to the recorded differences between the adult voice and child voice, it would be reasonable to assume that a separate protocol specially designed for assessing the child voice would be of benefit in therapeutic practice.

Similarly to assessing the adult voice, there has been a variety of ideas as to which voice parameters are of prime importance in perceptual assessment of the child voice. Hunt and Slater (2003) proposed that the prime vocal elements to be included in assessment are: the pitch and the pitch range of the child's voice; intensity of the child's voice; breath support and control used for generating vocal sounds; and the resonance of the child's voice. On the other hand, Eshnezi and her colleagues (1990) argued that pitch amplitude and the harmonics-to-noise ratio are fundamental elements in determining any vocal pathologies in the child voice. The differences between the decisions on which parameters to focus on, therefore, depend on whether the therapist relies on perceptual voice assessment or acoustic voice analyses as the prime assessment tool.

The fact that the anatomical and physiological structures of the child voice mechanism gradually change with age should also be taken into consideration (McAllister, 1997; Willis and Kenny, 2007) (see Chapter Two). For instance, the reference point of what is perceived as 'normal' may alter along with the physiological changes taking place as the child approach puberty (Nicollas et al., 2007). Since a number of different factors (such as those of physiological, psychological and sociological natures) (see Chapter Two) influence a child's voice quality and vocal functioning (Thurman and Welch, 2000), the process of determining vocal sound as 'normal' or 'abnormal' may be even further complicated (Andrews, 1991; Glaze, 1996; Weinrich et al., 2005).

The assessment process should consist of a set of different activities that the child clients can engage in, in order to gather a comprehensive set of voice data (Andrews, 1991; Hunt and Slater, 2003; Wilson, 1987). Andrews (op.cit.) formulated several activities that can be exploited in the assessment process in order to formulate a detailed profile for each child. For example, pictures can be used as prompts to provoke a child to speak. Different drawings can target different aspects of a child's vocalisation (such as volume used in speaking or a child's pitching ability) (Andrews, 1991). For instance, pictures that provoke a child to say specific words that consist of specific vocal sounds can be used in assessing specific vocal characteristics. Through such a process, a range of voice data are gathered for a reliable assessment outcome (Andrews, op.cit.).

Finally, it should be noted that conducting perceptual voice assessment may be a great deal easier with adults than with children due to the fact that adults are generally easier to co-operate with (Hunt and Slater, 2003). Professionals often need to spend time with child clients prior to assessment in order to establish a trusting relationship with the child client (Mathieson and Greene, 2003). Such a relationship can then be used on a basis for subsequent assessment and therapeutic session (Hunt and Slater op.cit.; Mathieson and Greene, 2003).

4.7 Consideration of holistic factors in perceptual assessment of the child voice

One difficulty in diagnosing a speech or a voice disorder is that it may be challenging to identify the original causal factor(s) behind such disorders (Blumental, 2006; Mathieson and Greene, 2003; Thurman and Welch, 2001; Wilson, 1987). It is standard practice to examine a child for potential physiological or anatomical abnormalities and malfunctions, particularly in the voice mechanism (Carding et al., 2000; Hirano, 1989; Yamaguchi et al., 2003). Such a process is usually performed by an ear-nose-and-throat specialist (Wilson, op.cit.). Hunt and Slater (2003) strongly argued that such practice is essential for conducting a comprehensive and accurate diagnosis of any pathological physiological factors that may be contributing to distorted vocal functioning and voice quality. A speech or voice therapist subsequently conducts the main voice assessment procedure, which is often performed with the assistance of a perceptual voice assessment protocol as discussed above (Hunt and Slater, op.cit.).

However, the original causal factors behind a speech or voice disorder may not necessarily be of physiological origin (Baker, 2002a; b; Hunt and Slater, 2003; Mathieson and Greene, 2003) (see Chapter Two). More specifically, such disorders can be the results of: a) functional disorders; b) communicative disorders; c) various psychological factors; or d) various sociological factors (Freidl et al., 1993; Hunt and Slater, op.cit.; Mathieson and Greene, op.cit.; Schalen et al., 1999). For instance, Schalen and her colleagues (op.cit.) reported that 35 per cent of their adult clients did not possess any physiological abnormality causing their vocal functioning or voice quality to become distorted, implying that the causal factors were of another origin.

Moreover, Rosen and Sataloff (1997) stressed the importance of conducting a comprehensive voice assessment process that takes a variety of factors into consideration. Such assessment process should ideally include an initial interview with the child client in order to determine any possible psychological factors behind the speech or voice disorder (Baker, 2002a; Mathieson and Greene, 2003). Such self-perception may highlight potential causal factors behind the client's disorder (Behman, 2004). Blumental (2006) further stressed the fact that both formal (such as physiological examination) and informal assessment approach (such as an informal interviews) that takes holistic factors into consideration should be conducted prior to commencing therapy in order for the intervention to be effective. However, only a few studies have investigated such claims. Such research would, nevertheless, provide valuable information for speech and voice therapy training that need to be addressed for effective and consistent therapeutic practice.

4.8 The bodymind and voice assessment

The importance of considering various causal and contributing factors in voice has been supported by a number of practicing professionals (Hunt and Slater, 2003; Mathieson and Greene, 2003; McAllister, 1997; Sederholm, 1996; Stemple, 1993; Thurman and Welch, 2000). The argument has been that our physiological and psychological sides are connected and, simultaneously, influence our vocal functioning and voice quality. Such connections are found through complex neural networks (Thurman and Welch, op.cit.) (see Chapters Two and Three). The original causal factor(s) may contribute to an imbalance in the individual's holistic entity that is closely connected to the complex neurological network (Mathieson and Greene, op.cit.). For example, a psychological factor (such as anxiety) may be investigating the physiological side of a child's voice production in the form of excess physiological tension and, subsequently, influencing the quality of the child's voice (Altman et al., 2005).

None of the existing formally-established protocols address all possible contributing and causal factors (such as a variety of physiological and psychological factors). When assessing for various causal and contributing factors, therapists have relied on a number of separate assessment tools rather than just one protocol or instrument. In addition to perceptual voice assessment, the therapists should conduct a thorough physiological, psychological and sociological assessment for each child client.

4.9 Potential inclusion of singing in the assessment of the child voice

Traditionally, speech and voice therapists have focussed on children's speech and speaking behaviours when assessing their vocal functioning and voice quality (Bores, 1984; Carding et al., 2000; McAllister, 1997; Sederholm, 1996). However, it may be the child's singing behaviour that is the root cause of a voice distortions (Rubin et al., 2003; Wilson, 1987). Therefore, it may be beneficial to assess the child's singing behaviour in order to eliminate any dysfunction in this particular vocal behaviour. More specifically, singing may be a useful diagnostic tool for vocal distortions. For example, an inability to sing within a particular pitch- range (such as in higher pitch) may provide implication of an underlying physiological pathology (Bunch, 1997). Singing behaviour requires a greater amount of volume and a wider pitch-range than speaking behaviour, implying that singing could be used as a tool to identify distortions in particular voice elements (Mathieson, 2000). The above argumentation indicates that singing could potentially be included in voice assessment in order to formulate a comprehensive profile for a child client, as well as to eliminate any original causal and contributing factors behind a child's vocal distortions.

As suggested in Chapters Two and Three, children's speaking and singing behaviours may potentially be connected via a variety of routes. However, an empirical study needs to be conducted in order to investigate such claims since it is not known whether professional therapists include singing in their practice and whether they are aware of the potential benefits of including singing in the assessment process.

4.10 Implications for the current study

Existing standardised formally-established perceptual voice assessment protocols have concerned children's speaking behaviour and speech rather than their singing. There are no perceptual voice assessment protocols that would have specially been formulated for assessing children's vocal functioning and voice quality in singing. Such claims indicate that there is a need for a comprehensive perceptual voice assessment protocol that would take both speaking and singing behaviours into consideration. Moreover, there is a need for a perceptual voice assessment protocol that would have specially been designed for children.

The above arguments indicate that there is a need for a perceptual voice assessment protocol that could be used internationally. Such a protocol could consist of comprehensive definitions for each voice parameter. It should also ideally be complimented by recorded examples of each parameter included in the protocol. Such voice examples would form a neutral baseline for the analyses process. The protocol should also be accompanied by a set of instructions as to how to use the protocol, as well as a set of tasks that can be exploited in the assessment process. Therapists could, then, be educated in relying on such voice samples in their practice. As a result of such training, professionals are likely to develop consistent skills in identifying pathological vocal sounds.

Based on the above arguments and an extensive literature review presented in this chapter, a perceptual voice assessment protocol addressing both speaking behaviour and singing behaviours was formulated (see Appendices for the full protocol). The protocol was piloted and, subsequently, used in the empirical phase of the study. In addition, instruments for collecting data on holistic causal and contributing factors were formulated. The main research questions proposed for the potential inclusion of singing in voice assessment with children were:

- Should singing be included in the perceptual assessment of the child voice?

- Should various holistic factors be taken into consideration when assessing the child voice?

- Is a perceptual voice assessment protocol that takes speaking and singing behaviours, as well as various holistic factors, into consideration a reliable and valid instrument in assessing the child voice?

Chapter 5: Experimental design and methods for the pre-pilot, pilot and main studies

5.1 Introduction

In this Chapter, the empirical phase of the study is presented. The empirical part of the study consisted of three phases: the pre-pilot study, the pilot study and the main study. The methods and data analyses approaches are discussed below, and justifications for each method and approach are provided. The exploratory nature of the study is stressed throughout the Chapter since the intention was to investigate the proposed phenomenon comprehensively (Mertens, 2005). The intention was to investigate the research questions in-depth in order to test the proposed theoretical framework empirically (Robson, 2002) (see Chapter Three). Subsequent to such an exploratory study, the proposed theoretical framework can be investigated further with a larger group of participants and perhaps through an alternative methodology (Searle, 2000).

The data collection part of the study consisted of different methods (see Figure 5.1). Distinct sets of data were gathered through the methods in order to approach the research questions from a variety of angles (Robson, 2002; Searle, 2000). The pre-pilot study consisted of observation and interviews. In the pilot and the main studies, the data triangulation consisted of: a) interviews; b) a survey; c) observation; and d) voice recordings (see Section 5.6 for more details). Each method was used in collecting sets of data from four different groups of children, with the participants across the groups initially being treated as one group and, subsequently, each group being treated as a case-study (Thomas, 2003).

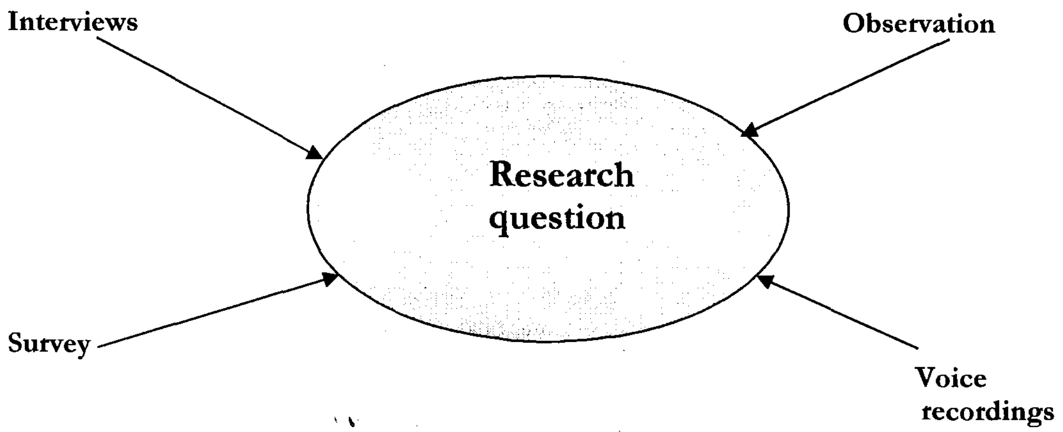


Figure 5.1: Model of the data triangulation

Observation was adopted as a data collection method in order to gather comprehensive ethnographic data on the phenomenon (Cohen et al., 2000; Robson, 2000). Observation was regarded a suitable method for investigating the phenomenon in-depth and in complementing the other data collection methods (Tashakkori and Teddlie, 2003). In addition, observation was used as a means to verify or to contradict data gathered through the other methods (Argosino, 2007). The nature of observation in this study was of focus-observation since particular pre-set aspects within the proposed phenomenon were primarily focused on during the observation activity, with the intention to remain on the initial research questions (Argnosino, op.cit.; Robson, 2002). In addition, the observation was of naturalistic nature since it took place in the settings that the participants were situated in on a daily basis (Argnosio, 2007).

During the initial phase of the study, the researcher was purely an observer in the natural school settings in order to formulate the exact research question and to design the study properly (Bloor, 2005). Observation during this phase focussed on various activities that the children were engaged in (such as reading a book, talking with peers and singing in music class). Additionally, the intension was to familiarize oneself with the participants (and vice versa) in order to minimize the researcher disturbance-effect (Gordon et al., 2005).As a result of such an activity, the presence of the researcher in the ethnographic environment during the primary observation phase influenced the gathered data minimally (Gordon et al., op.cit.). During the ethnographic observation, the researcher was also able to revise the speaking and singing tasks that had been formulated for the study. In the end of the observation, the research had revised the research questions for the study so that they were clearer and more concise. In addition, the researcher was able to design the empirical phase of the study properly.

At a later stage in the study, observation was used as a tool to verify information gathered through the interviews and the survey conducted with the participants (Gordon et al., 2005). The observations were open-ended in order to gather descriptive notes on the phenomenon under investigation (Searle, 2000). At a subsequent stage of the observation phase, participant-observation was conducted (Robson, 2000). More specifically, the researcher engaged in specific reading and singing tasks with the children in order for them to feel relaxed and familiar with her (Robson, op.cit.) (see Section 5.5). Observation was regarded as a more suitable approach for addressing the above aspects than, for instance, a survey since valuable information is less likely to be lost when the researcher can focus on the phenomenon in an open-ended way, provided that (s)he adopts a structured approach to the activity (Cohen et al., 2000; Robson, 2000).

Interviewing was used as a data collection method in the pre-pilot, pilot and main studies. In the pre-pilot study, interviewing was regarded a suitable data collection since the intension was to investigate professionals' concrete practices and their perceptions on the proposed theoretical framework in order to revise the research questions and to design the data collection methods for the main part of the empirical investigation (Robson, 2000) (see Chapter Three for the theoretical framework). Practicing speech and voice therapists were enquired whether they supported the proposed theoretical framework in their current practice and whether their perceptions on future practice reflected the theoretical framework. The objective was to use the findings from the pre-pilot study as a means to revise the proposed research questions and to design subsequent data collection appropriately (Punch, 2005; Seidman, 1991).

In-depth case-study interviews were regarded a suitable data collection method since such an interviewing process provided the researcher with detailed and comprehensive information on practicing professionals' current practices, concrete experiences and personal views (Cohen et al., 2000; Kvale, 1996; Robson, 2003). Furthermore, interviewees may feel more comfortable to self-disclose subjective information in more intimate interview situations that has created a trusting atmosphere is created (Johnson, 2002). 'An interactive approach' was adopted to the interviewing process (Payne, 1980). In such an approach, each professional was interviewed on at least two occasions (Payne, op.cit.). A subset of the interviewees was contacted up to five times in order to gather additional information and to clarifying findings from the initial interviews.

In the pilot and the main studies, interviewing was regarded as a suitable method for gathering information on the participant children's subjective experiences and perceptions of the proposed phenomenon (Eder and Fingerson, 2002). Both the interviews and the survey were conducted in the children's natural school setting in order to minimise the experimental bias (Eder and Fingerson, op.cit.). Interviews and the survey were regarded as suitable methods for gathering information on the children's psychological and sociological background characteristics (Mertens, 2005; Kvale, 1996). Interviews gathered broader, open-ended and subjective background information for each child, whilst the survey gathered information on more specific and pre-determined background factors (such as the age of the participants) (see Appendix 1 for the interview and survey schedules).

In the interview situations, participant children were provided with an opportunity to express subjective accounts in a self-reflective and open-ended manner, as the objective was to learn about the participants' self-perceptions and subjective experiences (Eder and Fingerson, 2002). The survey, on the other hand, gathered background information in a more structured way and provided the researcher with more factual information on the children (Cohen et al., 2000). Therefore, information gathered through these two methods complimented one another and provided the researcher with information needed for investigating the proposed phenomenon (Cohen et al., op.cit.).

In the pilot and the main studies, replicated empirical voice recordings were conducted in order to investigate any similarities and differences between children's vocal functioning and their voice quality in their speaking and singing behaviours (Andrews, 1991; Sederholm, 1996; Sundberg, 2001). Controlled, high-quality voice recordings were regarded as a reliable tool for such a purpose and in comparing the participant children's vocal functioning and voice quality between these two vocal behaviours, with the intention to test the proposed theoretical framework empirically (Robson, 2000; Sundberg, op.cit.) (see Chapter Three). Specific speaking and singing tasks were designed for the voice recordings. The tasks were formulated on the basis of an extensive literature review that focused on the most common tasks exploited in professional speech and voice therapy practice (Aitman et al., 2004; Andrews; 1991; Baker, 2002; Colton and Casper, 1996; Diliyski et al., 2004; Eedie and Doyle, 2004; Hunt and Slater, 2003; McAllister, 1997; Sederholm, 1996; Tanner et al., 2004; Velsvik-Bele, 2004; Whiteside and Hodgson, 2001; Weinrich et al., 2005; Yamaguchi et al., 2003) (see Chapter Four). The speaking and singing tasks exploited in the pilot study were those that professional speech and voice therapists used most regularly in their practice with child clients, as indicated by the literature review (see Chapter Four). The tasks were modified on the basis of local observation in order for the tasks to be suitable for the participating children (see Section 5.6.4).

The separate data sets were triangulated in order to draw objective conclusions from the study (Mertens, 2005). Such data triangulation enabled the researcher to investigate the phenomenon from a variety of angles (Searle, 2000; Travers, 2001) (see Chapter Two). The methods were complimentary to one another by providing data on the same phenomenon from a variety of perspectives (Searle, op.cit.). Data triangulation was regarded as a suitable approach for maximizing the reliability of the findings from the study (Robson, 2000).

All of the participants were treated as one group in the initial phase of the study. In a subsequent phase, the children from four different groups were treated as separate case-studies (Cohen et al., 2000). Case-studies were used as a starting-point for exploring the proposed phenomenon since such a study typically consists of descriptive details of a specific entity (such as a specific group of participants) (Thomas, 2003). Case-studies can be used as a means to highlight distinct features and characteristics of a phenomenon, consequently emphasising the strongest features of each case. Subsequently, new valuable information on the phenomenon is likely to be provided for the researcher (Thomas, op.cit.; Searle, op.cit.).

Furthermore, the different natures of the data collection methods complimented one another (Grbich, 2004: Tashakkori and Teddlie, 2003). The observations used in the study were of ethnographic nature (Tashakkori and Teddlie, op.cit.), whilst the voice recordings, questionnaires and interview were parts of the controlled data collection phase of the study (Robson, 2000). The purpose of the controlled data collection phase was to gather data in a controlled environment in order to minimize the impact of uncontrolled factors on the findings from the study (Grbich, op.cit.). In the voice recoding phase, such an approach was necessary in order to gather high quality voice data without much external disturbance (Sundberg, 1996).

Both the speaking and the singing tasks were conducted in under controlled experimental conditions (see Section 5.6.7 for more details). The interviews and the questionnaires were also conducted under such controlled conditions in order for the participants to remain focussed on the tasks and, subsequently, to gather reliable voice data (Sundberg, 1996; 2001). The ethnographic phase and the controlled-data collection phase complemented one another, as they provided the researcher with detailed information on the phenomenon from a variety of perspectives. The nature of the methods generated the data that was needed for exploring the proposed research questions, as well as the hypotheses for the study.

5.2 Pre-pilot study: interviews and observations with professional speech and voice therapists

Prior to commencing the main empirical phase of the study, a pre-pilot study was conducted in order to clarify the research questions. The pre-pilot study consisted of interviews and observations with professional speech and voice therapists. As mentioned above, an interactive interviewing approach was adopted to the pre-pilot study in order to gather in-dept information for investigating the research questions (Cohen et al., 2000; Kvale, 1996; Robson, 2000).

5.2.1 Piloting and formulating the interview items

Prior to conducting the interviews, interview items were piloted via an online survey with a small number of participants (N=5). The purpose of such a process was to ensure that the questions to be included in the interviews generated the desired information (see Appendix 1 for the schedule).

The nature of the interview items was semi-structured and open-ended, as such an approach allowed the interviewees to provide detailed explanations on their experiences and perceptions on the theoretical framework (Robson, 2000) (see Table 5.1). The semi-structured nature also enabled the interviewer to supplement pre-formulated items with additional ones in the interview situation for clarification purposes and for further information when needed (Cohen et al., 2000). The pre-formulated questions kept the interview in its initial focus and enabled the interviewee and the interviewer to concentrate on the interview themes (Payne, 1980; Seidman, 1991). The interview items were formulated on the basis of an extensive literature review, based on which the proposed theory had also been built (see Chapter Three). Fifteen specific questions on the theory were used as the main interview items (see Appendix 1 for the interview schedule).

'Do you consider physiological/ anatomical/ neurological and biological causal factors when assessing the 'normality' and 'abnormality' of the child voice?'
'Do you feel that assessing the 'normality' and 'abnormality' of the child voice is a challenging task?'

Table 5.1: Two examples of the items included in the interviews with the professional therapists

The contact details for the therapists had been obtained from the membership list of the Royal College of Speech and Language Therapists (www.rcslt.org) due to the fact that all the therapists who were members of the Royal College were qualified professionals in their field. The administrator of the organisation was contacted in order to obtain the contact details. An email with the questionnaire as an attachment was sent to 15 potential participants in the UK in order to enquire on their willingness to participate in such a research study. The therapists were assured of confidentiality issues. They were informed that the data were to be treated with the strictest of confidentiality and according to the guidelines set by the British Educational Research Association (BERA). The participants were assured that the information was to be used for the purposes of the current study only, and it was not to be passed on to a third party.

Five therapists responded to the questionnaire within two weeks from receiving the email. Each of them was located at a different speech or voice therapy clinic across London and Kent. Two of the clinics were part of the National Health Service and the remaining three were private practice. All of the respondents had been working in the field between two and ten years. Children formed 10-60 percent of their client population.

The results from the electronic survey were analysed with the assistance of NVivo-software. The main finding was that there was a wide range of factors that needed to be addressed in the main study in order to gather comprehensive data for investigating the proposed phenomenon. For instance, there was a variety of reasons for why the professionals did (or did not) include singing in their practice. Therefore, a greater number of specific questions on the function of singing in their practice were formulated for the main data collection phase. Such functions were explored from the physiological, psychological and sociological perspectives. Nevertheless, the questions were found to be reliable and valid. Subsequently, the initial questions were elaborated and additional questions were formulated in order to supplement the existing ones in the main phase of the study.

5.2.2 Interviewees in the pre-pilot study

Eight professional speech and voice therapists were interviewed in the main phase of the pre-pilot study. The interviewees had been selected on the basis of prior professional contact, as well as on the basis of the fact that the individuals were regarded to be the leading professionals in their field, as indicated by their international reputation. Each one had practiced as a speech or a voice therapist for at least ten years.

The therapists were resident in four different European countries (i.e. the UK, Finland, Sweden and Croatia). They practiced at more than one clinic, with the majority of the clinics belonging to the National Health Service. Six of them carried out additional consulting for other professionals in the field. Children formed at least one third of their client-population. All the participants were female, with their average age being 38. Although their professional title was a Speech and Language Therapist, all of them had specialised in voice therapy, specifically

5.2.3 Ethical issues

As with the electronic survey, the interviewees were assured of confidentiality issues. They were informed that the data were to be treated with the strictest of confidentiality and according to the guidelines set by the British Educational Research Association (BERA). The participants were assured that the information was to be used for the purposes of the current study only, and it was not to be passed on to a third party.

5.2.4 Procedure for interviews

The therapists were contacted electronically in order to enquire about their interest in participating in the research study. They were reminded of the ethical issues. All of the therapists responded within five working-days and expressed their interest to participate in the study, provided that the ethical guidelines were to be followed at all times.

The times for the interviews were also arranged electronically. The order of the interviews was random, constructed on the basis of first-response. Two of the interviews were conducted face-to-face since the interviewees were residents in the UK. The remaining interviews were conducted on the phone since the interviewees were resident outside the UK and, therefore, it was not feasible for the researcher to conduct the interviews face-to-face.

The length of each interview was approximately 40 minutes. The interviews were recorded with a minidisk player and they were transcribed subsequently. The transcriptions were then analysed with the assistance of Excel-software. As mentioned above, the interviewing process was of interactive nature. Therefore, the interviewees were contacted for additional information and for clarification purposes, subsequent to analysing the data from the initial interviews and to having identified any 'gaps' from the data. Two of the interviewees were contacted up to three times, two for one additional time; and one for up to five times in order to gather all the needed data. The interactive interviewing process took up to three months to complete.

5.3 Findings from the pre- pilot study

The results from the interviews were analysed according to three broad categories, that had been formulated on the basis of the responses received for the electronic survey. The categories were: a) inclusion of singing in voice assessment; b) inclusion of singing in therapy sessions; and c) perceptions of therapists as to the potential inclusion of singing in therapy sessions.

5.3.1 Inclusion of singing in voice assessment

All of the interviewed therapists stated that they focussed on children's speaking behaviour rather than their singing behaviour when assessing the children's voice for any vocal distortions. Only one of the English therapists stated that she looked at children's overall vocal functioning and voice quality in more general terms rather than their speaking and singing behaivours as separate entities. For all the therapists, nevertheless, the main focus of the assessment remained on speech.

The reasons for focussing on speaking behaviour varied amongst the therapists. The stated reasons were: a) children are speaking (not singing) most of the time and, therefore, speaking is of prime importance; b) speech is a beneficial diagnostic tool for any vocal disorder; and c) most often children who had been referred to therapy possess severe difficulties with their speaking behaviour or language-use rather than with their singing behaviour or their overall vocal functioning.

Three of the therapists stated that they always included singing in voice assessment; three others stated that they sometimes took singing into consideration during the assessment process and two therapists stated that they very rarely took singing into account when conducting their assessment. One of the English therapists reported that she used pitch-glides as a diagnostic tool since these usually demonstrate whether there are any segments in the client's overall vocal output, or these may reveal particular physiological abnormalities that have not been detected from speech. For instance, children with vocal nodules may not be able to produce pitches in a higher range and this could, instead, be tested with the use of pitch-glides. The other English therapist stated that she used a broader range of more general vocal exploration techniques in order to gain a comprehensive picture of a child's overall laryngeal functioning. In particular, pitch work (as mentioned above) was considered to be useful. In addition to the English professionals, the Croatian expert reported to be using basic singing forms and mumblings in gaining a comprehensive view of the child's overall vocal skills.

One of the Finnish professionals stated that singing could be used as a means to gain closer contact with the child and as a means to enable the child to relax during the therapy sessions. The other Finnish therapist claimed that singing itself may be the abusive vocal behaviour that is causing the child's voice in speaking to become distorted and, therefore, singing should be included in voice assessment. However, she reported that the inclusion of singing in therapy sessions depended on whether the child was willing to sing and whether the child's vocal distortion seemed to extend to singing. The Swedish professionals, on the other hand, reported that singing could be looked at with the help of a phonetogram (see Section 3.2.2). However, it was rarely the focus of the assessment process.

5.3.2 Inclusion of singing in therapy sessions

The interviewees used a variety of practices as to their inclusion of singing in their therapy sessions. The English therapists reported that they included singing in their therapy sessions on a regular basis; the Croatian and Finnish professionals stated that they used simple singing forms when appropriate and suitable for the client once the client's needs and background had been taken into account; the Swedish professionals stated that it was a challenge to include singing in the therapy sessions since it could take time for children to be willing to engage in such activities since all of them may not be able to sing or they may not be used to singing.

The main reasons for the therapists to include singing in their sessions were the relaxing properties associated with singing and the fact that children seemed to enjoy singing. It was also reported that singing could be used as a means to gain more intimate contact with the child. Two of the therapists reported that, through singing, the child could be provided with an aesthetic model for all voice use. However, it was argued that it depended on the nature of the vocal distortion whether singing was to be included in therapy. For instance, it would not always be appropriate to include singing in the treatment of more severe voice distortions since singing could potentially increase the physiological tension in the voice mechanism rather than decrease it. This, in turn, may deteriorate rather than enhance the child's overall vocal functioning and voice quality.

5.3.3 Perceived benefits of singing in therapy sessions

The interviewees had very different views as to the potential benefits of including singing in their practice. One of the therapists argued that the benefits were mainly of physiological nature, as singing could be used as a means to educate the child in using his/ her voice mechanism efficiently. Two of the therapists claimed that the benefits were mainly of psychological origin. They claimed, for instance, that singing was less threatening and more enjoyable than traditional voice and speech therapy techniques were for children. All of the therapists placed great importance on the relaxing properties of musical elements. One of the therapists argued that singing was beneficial from both the physiological and the psychological perspectives, whilst another therapist stated that any activities (including singing activities) that may assist in mastering speaking skills or enhancing the quality of a child's voice were perceived as beneficial for speech and voice therapy practice.

The Swedish therapists, who stated that they did not include singing in their therapy sessions argued that it was extremely difficult to transfer any improvements achieved in singing behaviour into speaking behaviour. These therapists also regarded speaking and singing as two completely different sets of behaviours, although they did acknowledge that singing could be used as a means to measure laryngeal functioning in the assessment process when the child had 'a fairly good ear for singing'.

In summary, there were great differences amongst therapists as to the inclusion of singing in their practice in both assessment and therapy sessions. The reasons for including (or for not including) singing in their practice were based on personal experiences rather than scientific or empirical evidence on the effectiveness of singing activities. The findings indicate that the area of including singing in speech and voice therapy practice is under-researched. Based on the findings, the original research questions for the study remained as they had initially been set.

5.3.4 Summary

The above findings indicate that was a wide variety of reasons for including and for not including singing in professional speech and voice therapy practice amongst the interviewed therapists. Such variety in practice seemed to be a result of a lack of scientific and empirical data on the effectiveness of singing activities in such professional settings.

5.4 Observation at speech and voice therapy clinics

Observation was conducted at four of the speech and voice therapy clinics that the therapists were positioned at in order to verify the findings from the interviews conducted with the therapists. Four clinics were randomly selected from the workplaces that the interviewed therapists were positioned at. Two of the clinics were in the UK (one in London and one in Kent) and two were in Sweden (in greater Stockholm area).

It was not feasible to conduct observation at all of the voice clinics where the interviewed therapists were positioned at due to the fact that the clinics were located in different countries, making it impossible for the researcher to visit all of them. The UK was chosen since the researcher was resident in that country. The clinics in Sweden were chosen since the researcher conducted a research visit to the country and, therefore, it was feasible to visit the clinics in that country. Both of the clinics in Sweden and one of the clinics in the UK belonged to the National Health Service; one of the clinics in the UK was private. The clinics administered speech, language and voice therapy to both adult and child clients.

The directors of the clinics, as well as the interviewed therapists, were contacted prior to the visit in order to obtain permission for the research study. Once permission was granted by the clinicians, the clients whose sessions were to be observed were contacted for obtaining their permission for the research study. Throughout the whole study, the ethical guidelines of the British Educational Research Association (BERA) were followed.

90 per cent of the clients in the observed sessions were children. The duration of each observation was approximately 40 minutes. The researcher adapted a role as an

ethnographical observer in the clinical settings in order not to interfere with the observed phenomenon (Cohen et al., 2000). The researcher sat in the corner of the therapy room quietly throughout the therapy sessions. In total, ten patients were observed at four clinics. The observations focussed on the three themes that the interview questions were focussed on. Observation sheets were used as a means to organise the observations (see Appendix 1 for the full observation schedule and examples ondfobservation data). The interview questions were revised for the observation sheet in order for the two methods to be investigating the same phenomenon.

The findings from the interviews were verified in the observation phase. It was confirmed that the English professionals included singing in their session when they perceived such an approach as being appropriate, whilst the Swedish professional did not include singing in their practice to any extent. A new finding was that all of the therapists included melodic lines and chanting, rather than formal singing, in their therapy sessions and in voice assessment.

In summary, the findings from the interviews were verified in the observation phase. A new finding was that melodic lines and chanting rather than singing were used in professional speech and voice therapy practice.

5.5 Observation in schools

Prior to the pilot and the main studies, observation was conducted at the schools where the data collection was to take place. The researcher observed the participant children in different school settings (i.e. the classroom, school yard and assembly) in order to observe their voice use, as well as to revise the speaking and singing tasks that were to be used in the pilot and main studies.

Observation during this phase focussed on various activities that the children were engaged in (such as reading a book and singing in music class) (see Section 5.1). At a subsequent stage of the observation phase, the researcher also engaged in particular reading and singing tasks with the children in order for them to feel relaxed and familiar with her.

At the school located in London, observations were conducted twice a week for a month prior to designing the exact data collection methods for the pilot and the main studies. In the Finnish school, observation took place for a day prior to data collection due to time-constraints. At both schools, the children were also interviewed informally for approximately five minutes in order to gain an idea of their background factors and the type of singing training that they had received prior to formulating the final speaking and singing tasks. Informal interviews were also conducted with the classroom teachers in order to enquire about suitable speaking and singing tasks to be included in the experiments. Based on the outcomes from the above procedure, the speaking and singing tasks to be used in the voice recordings were revised for the experimental phase of the study.

The voice assessment protocol to be used for the study was piloted through a set of speaking and singing activities with the children who participated in the pilot study (see Setion 5.7 for more details on the protocol). The protocol was piloted through observing the children engaging in a variety of speaking and singing tasks. For instance, individual attention was given to one child at a time during a music lesson and an English lesson so that the protocol could be piloted via both speaking and singing tasks. The researcher sat next to one child at a time for approximately five minutes when the child was engaged in speaking, reading or singing and filled in the voice assessment protocol. Five minute-long informal interviews were also conducted with the children in order to test how the protocol fulfilled its function with speech data. Such a process was also used for piloting the interview items.

5.6 Observation, interviews, voice recordings and a survey as the pilot and the main studies

The pilot study and the main study consisted of an in-depth, exploratory investigation with pre-pubertal children aged between 7 and 10 years (Mertens, 2005; Yin, 2003). The objective was to gather data on the participant children's vocal functioning and voice quality in their speaking and singing behaviours, as well as to investigate a variety of factors potentially influencing their vocal functioning. As explained in Section 5.1, both ethnographic (i.e. observation) and controlled (i.e. interviews, survey and voice recordings) data collection methods were exploited.

5.6.1 Participants

Since the aim of the study was to investigate the phenomenon of the child voice, children from an age-specific population performed as the participants (Cohen, 2000). Since previous studies researching children's vocal functioning and voice quality had focused on 10-year-old participants, this particular age-group was chosen for the current study. Focussing on such population enabled one to draw comparisons between the current study and the existing data on children's vocal functioning and voice quality. Furthermore, the previous studies had for the most part been conducted outside of the UK (McAllister, 1997; Sederholm, 1996). Therefore, the current study brought about new information on the child voice in the UK.

In addition, a group of 7-8-year-olds formulated an additional group for comparative purposes and for investigating whether any general trends arising from the data with 10-year-olds were also applicable to younger children. Therefore, the exploited sampling method was purposive (Mertens, 2005; Thomas, 2003). It should be noted that previous studies had focussed on children's speaking behaviour and speech. The current study focussed on both speaking and singing, therefore, generating new information on children's vocal functioning and voice quality in both of these vocal behaviours.

Four different groups of children formed the participant population: three different groups consisting of 9-10-year-olds and one group consisting of 7-8-year-olds. The first group was treated as the pilot study in order to test the experimental design prior to commencing larger-scale data collection (see Appendix 2). This particular group was from a school located in western London (see Section 5.6.2 for more details on the school). The participants were 9-10-year-olds. The second group was from the same school, also with 10-year-old children. The third and the fourth groups were from a school in Finland. The third group consisted of 9-10-year-olds and the fourth group consisted of 7-8 year-olds.

The sampling method was purposive since children of a particular age were to be used as subjects for the study. Ten-year-olds were regarded as suitable subjects since the majority of previous research studies on children's vocal functioning and voice quality had concerned this particular age-group (see Chapter Two). In addition, children of this age normally have not yet started undergoing voice change, indicating that the physiological changes taking place in puberty have not yet started influencing the children's overall voice quality and vocal functioning. The group of 7-8-year-olds was also chosen on the basis that such young children have not yet started undergoing voice change.

Since the study was of explorative nature and since the only criteria for the participating children was their age, the school in the UK was chosen on the basis of prior professional contact. The school in Finland was selected on the same basis. Another reason for choosing these particular schools was that the schools were located at different geographic locations and, therefore, it may be possible to explore any general trends emerging from the data with participants from a variety of backgrounds. Due to strict access to schools, prior contact was essential in order for the researcher to have access to the schools.

5.6.2 Participating schools, their National Curricula for music and further information on the participating children

As stated above, the two schools were the participants from were located in different countries: the UK and Finland. Therefore, the National Curricula and the structure of their music lessons differed between the schools, as described below.

5.6.2.1 The school in the UK

The school in London was a state primary school. It was located in East Acton, in western London (see Figure 5.2). It has been described by OfSted in the following way (www.ofsted.gov.uk):

'xxx is larger than most primary schools and it is attended by 225 girls and boys between the ages of four and eleven in the main school. A further 51 children attend the nursery, 40 of these on a full-time basis. Children are admitted to the reception class at the start of each term. There is a similar number of boys and girls attending the school. The school serves the area around East Acton, and includes a high percentage of refugees and families in temporary accommodation. This leads to the school having a high rate of mobility, which adversely affects standards. Attendant on entry to the school is generally well below average. About half of the pupils are on the school's register on special educational needs, which is well above average. The majority of the children with special education needs have moderate learning difficulties but other difficulties include emotional and behavioural, speech and communication, and physical disabilities. Five pupils (1.6 per cent) have statements about special educational needs, which is about average. Over half of the pupils are from ethnic minority groups and English is an additional language for 126 pupils, of whom 101 are at an early stage of learning English. The main first languages are Arabic and Somali, but up to 25 other languages are also spoken. The proportion of pupils entitled to free school meals is 52 per cent, which is well above the national average.'

The description above indicates that the children who attend the school were from a variety of backgrounds. Therefore, great cultural differences were recorded amongst the participant children within one classroom.

As based on local observation by the researcher, the school building was relatively old: the acoustics inside the school were not voice-friendly; the corridors and the classrooms were fairly large and, subsequently, any sounds produced an echo-effect. The noise level in the classroom was also relatively high throughout the day, due to the fact that the children talked amongst themselves throughout the lessons without the classroom teacher feeling the need to control their voice use.

For the 9-10-year-olds, the content of the music lesson, as stated in the National Curriculum, were described as follows (www.direct.gov.uk/en):

'Pupils identify and explore the relationship between sounds and how music reflects different intentions. While performing by ear and from simple notations they maintain their own part with awareness of how the different parts fit together. They improvise melodic and rhythmic phrases as part of a group performance and compose by developing ideas within musical structures. They describe, compare and evaluate different kinds of music using an appropriate musical vocabulary. They suggest improvements to their own and others' work, commenting on how intentions have been achieved.'

The description in the National Curriculum for music lessons is relatively flexible by allowing individual teachers to design their lessons freely. Such flexible curriculum design indicates that there may be great variations amongst teachers as to how they carry out their music lessons. It should be noted that the children who participated in the study had a classroom teacher who was a music specialist. Therefore, the music lessons were planned so that the children in the classroom would be able to participate in a variety of musical activities. Children in this class had one formal music lesson lasting for 50 minutes every week. In addition to the music lesson, the teacher occasionally used music as a means to provide the children with a short 10-minute break between lessons in other subject disciplines. Thus, the children in their particular classes were extensively engaged in music and were provided with well-designed music lessons.

5.6.2.2 The school in Finland

The school in Finland was a primary school, covering the age-range of 5-12. The school in Finland was described the following way based on local observation, conversation with the Head teacher of the school and the school syllabus (www.espoo.fi):

'The school is located in an area in the town of Espoo in southern Finland (see Figure 5.3) that has a mixture of middle class, working class and upper class inhabitants. There are some immigrant children in the school, although the percentage of them is low (approximately 5 %). The main aims behind the school's educational philosophy are to foster the will and the happiness to learn. The teaching approaches are child-centred, with the aim to encourage the children's curiosity and healthy development of self-esteem. ICT and the library are used on a daily basis. The children are seen as members of the school community in the form of active participators. The children's learning is being developed according to his/ her developmental stage. The purpose of music education is seen as an activity that promotes the development of the children's emotional lives and also fosters creativity. Music is seen as a medium that affects the children in both holistic and individualistic terms. Being active in music class is seen as essential. The activities that are fostered in the class are: singing, canon singing, choral singing, playing different musical instruments, listening to different types of music, music technology and working on different musical projects.'

As based on local observation, the school building was perceived as relatively old. The rooms were spacious, with plenty of space for different types of activities. The acoustics in the rooms were voice-friendly and did not pose extra demand on the children's voice use. The children were not allowed to scream or shout inside the school. The children aged 9-10-years were quiet in the classroom for most part. Subsequently, there was no need for them to raise their voices in order to make themselves heard. They seemed to obey the classroom teacher well. They were not allowed to talk throughout the lessons either.

The above description was set by the specific school, in accordance to guidelines set by the Finnish Ministry of Education. In Finland, each school has a great deal of freedom in developing its own curriculum for each subject discipline. Therefore, there may be wide differences between schools and teachers as to how music is taught at different schools. In this particular school, emphasis was placed on different singing activities. Detailed description was provided in the school syllabus as to the types of musical activities that should be included in the music curriculum. The classroom teachers for both of the groups of children from this school were specialists in music. Therefore, they designed their music lessons so that each one of them consisted of a variety of musical activities in order to foster the children's musical development.

The children aged 9-10 years had been singing on a daily basis for 3 years. They sang for at least 15 minutes each day at school in addition to a regular music lesson twice a week. In the music lessons, the objectives for this particular age group were: to be able to use one's voice freely and in a confident way; to learn to use melodies and rhythms in composing music; to learn to listen to and to distinguish between different types of musics; and to learn to understand world music.

For the 7-8-year-olds, music lesson were taught once a week and they lasted for 90 minutes at a time. The aims of music education for this particular age-group were to: practise being musically engaged in singing and in playing musical instruments; learn to use one's voice; learn about different musical instruments; learn to listen to different types of sounds; learn to move to music; and learn to use different sounds as parts of musical compositions.

The children had sung on a daily basis for the past two years, based on the practice that a number of tasks were taught through singing at the school. For instance, the alphabet had been taught through singing. Such an approach had enabled the children to learn to use their voices in a confident and flexible way.

It should be noted that that the age-groups for each grade differed slightly between Finland and the UK. In Finland, children enter school in the September of the year during which they turn seven. Thus, in second grade, one normally finds children between the ages of 7 and 8. In the fourth grade, one normally finds children between the ages of 9 and 10. Thus, the age-difference between children in the same class can be almost one year and, hence, the age variations within one class may be significant. This is a difference to the UK where children enter school in the autumn of the year when they have turned six.

5.6.3 Fieldwork design

As mentioned above, each group of children was treated as a case-study. Such an approach enabled the researcher to go in depth with each group in order to: explore the research questions comprehensively; explore specific features and characteristics of these particular cases; and provide groundwork for subsequent research (Bassey, 1999; Travers, 2001). The data collection methods for each case-study were: experiments in the form of voice recordings; interviews with the participant children and the classroom teachers; and questionnaires with the participant children.

5.6.4 Speaking and singing tasks used for the voice recordings

In order to investigate any similarities and differences between children's overall voice quality in speech and that in singing, replicated voice recordings were conducted (Andrews, 1991; McAllister, 1997; Sederholm, 1996). Controlled, high quality voice recordings were regarded as a reliable tool in comparing the participant children's voice quality in speech to that in singing in order to test the proposed theoretical framework empirically (see Chapter Three) (Robson, 2000; Sundberg, 2001).

Specific speaking and singing tasks were designed for the experiments (see Figure 5.4) (see Chapter Four). The tasks were formulated on the basis of an extensive literature review (Aitman et al., 2004; Andrews; 1991; Baker, 2002; Colton and Casper, 1996;

Diliyski et al., 2004; Eedie and Doyle, 2004; Hunt and Slater, 2003; McAllister, 1997; Sederholm, 1996; Tanner et al., 2004; Velsvik-Bele, 2004; Whiteside and Hodgson, 2001; Weinrich et al., 2005; Yamaguchi et al., 2003). The tasks were, subsequently, modified through local observation in order for them to suit the participating children. The speaking and singing tasks exploited in the pilot study were those that professional speech and voice therapists used regularly in their practice with child clients, as indicated by the above literature review. It was believed that such tasks would generate the samples of voice data that were needed for the purpose of the current study (see Figure 5.2 below for an example of a speaking task; see Appendix 1 for all the tasks).

IMAGE SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

Figure 5.2 Pictures used for provoking the children to talk spontaneously as an example of the tasks

The tasks varied slightly between the different groups of children in order for all the participants to be able to engage in the tasks and in order to minimize the experiment-bias (Andrews, 1991; Mathieson and Greene, 2003). In regard to speaking, three different tasks were used: reading a pre-selected text passage (as selected by each classroom teacher prior to commencing the main data collection); talking spontaneously as provoked by a picture (as chosen by the researcher); and talking in a formal interview situation in response to questions on one's attitude to one's own voice and to singing (see Section 5.12 for more details). Each task provided detailed voice data on the children's speaking behaviour. In regard to singing, two tasks were used: pitch-glides (as demonstrated by the researcher) and singing a simple song (as selected by each child individually). After the pilot study, it became evident that singing was a useful task to be included in the experiment, but the pitch-glide task did not generate any additional information and , therefore, it was excluded from subsequent data collection (see Chapter Four for more information on voice assessment).

As part of the voice assessment process, the children's perceived speaking and singing competencies were evaluated (see Appendix 1 for the protocol). The intension was to investigate the effect of perceived speaking and singing competency on the children's vocal functioning and voice quality in regard to both their speaking and singing behaviours. Such a process was conducted with the use of the voice tasks formulated for gathering data on the overall quality of the children's voices. Additional information on their speaking and singing competencies was gathered via observing the children being engaged in speaking and singing tasks outside the experiment situation. Finally, the classroom teacher was interviewed informally on the children's perceived speaking and singing competencies. The teachers were also asked to rate each child in terms of their perceived speaking and singing competency.

The children's perceived speaking competency was assessed via the National Test in Oral and Speaking Competency (see www.ofsted.gov.uk for more details). This is a test that is used in assessing pupils' oral fluency at National Level. A new protocol was formulated for assessing children's perceived singing competency in order to carry out a comprehensive assessment. The protocol was based on the singing assessment protocols, developed by Welch (1985) and Rutkovsky (Mang, 2001). The two singing competency assessment protocols were combined in order to formulate a comprehensive protocol for assessing the level of the children's perceived singing competency (see Appendix 1 for the full protocols).

As with the protocol assessing overall voice quality, these particular protocols consisted of continuous seven cm-long lines (i.e. a Visual Analogue Scale). The left end of the line represented lower level of competency and the right end of the line represented higher level of competency. There were nine items on each protocol (see Appendix 1 for the protocol). Each item represented a statement on the child's perceived speaking or singing competency. The items has been formulated by the researcher on the basis of the existing protocols. For example, in regard to speaking competency, the first item was 'Listens and responds appropriately, speaks audibly and provides some detail in their accounts', whilst the last item was 'Talks with the use of expressive vocabulary the use of standard English'. The singing protocol, on the other hand, ranged from 'Word of song of initial interest and chant-like singing' to 'use of extended vocal pitch-range'. Each item was given a rating on a seven-point scale. In the end, the scores were added up for a composite rating that represented the child's perceived speaking competency or singing competency. On each scale, the score of 63 represented the highest level.

5.6.5 Questionnaire and interview schedules

Interviews and a survey were regarded as suitable methods for gathering information on the children's psychological and sociological background characteristics (Mertens, 2005; Kvale, 1996). Interviews generated detailed background information, whilst the questionnaires gathered information on essential background factors for the children (such as the age of the participants) (see Appendix 1 for interview and questionnaire schedules). Both the interviews and the survey were conducted in the children's natural school setting in order to minimise experimental bias (Eder and Fingerson, 2002).

More specifically, the interviews focussed on the children's attitudes and perceptions on singing, vocal functioning and voice use (see Table 5.2 below and see Appendix 1 for full interview schedule). The interview schedule consisted of seven specific questions on the above themes. The questions were formulated on the basis of an extensive literature review (see Chapter Three). The interview items were piloted with five children prior to conducting the primary interviews and found to be reliable in gathering the needed voice through qualitative analysis data (see Section 5.6).

'What is the main instrument you use for singing?'
'Do you like the way your voice sounds when you speak?'

Table 5.2: Two items as examples from the interview schedule

Two different questionnaires and a personality inventory were administered to the children in order to gather further information on their background factors. The personality inventory used was the Eysenck Junior Personality Inventory (see Table 5.3 below and see Appendix 1 for the full test). This particular inventory was used because it was a well-know test in the field of personality testing with pre-pubertal children (Maqsud, 2005). Moreover, the inventory covered major personality characteristics well

(Maqsud, op.cit.). Both of the exploited questionnaires were developed on the basis of the literature review (see Chapter Three). The first one consisted of three sections: one for personal background information, one for musical hobbies and training and one for received singing training. The same one focussed on sociological factors and the children's hobbies.

Do you like singing? yes no
Why do you like singing/ why do you not like singing?

Table 5.3: Two items as examples from the questionnaire schedule

In addition to the questionnaires and the interviews, information on the children's background factors was gathered from the school records. Permission for using the information was requested from the head teachers and the parents of the children. The additional information gathered from the records concerned the children's socioeconomic status and the results from the National Reading Test that was used for identifying the children with diagnosed reading difficulties.

As with the interview questions, the questionnaire items were piloted with five children prior to commencing the main data collection. Subsequent to the pilot study (i.e. the first group), the questionnaires were revised so that the term 'gender; was changed into 'sex', and the term 'voice element' was changed into 'instrument'. Such changes clarified the questions so that they were likely to be more easily understood by the children in subsequent stages of the research study.

5.6.6 Ethical issues

Prior to commencing any data collection, approval was obtained from the Head Teachers of the schools, as well as from the classroom teachers. Once approval had been granted by the teachers, the parents of the participating children were contacted for parental approval. A letter was sent to the parents by the classroom teacher (see Appendices for the letter). The responses were returned to the classroom teacher and, subsequently, to the researcher. At the Finnish school, two out of 24 9-10-year-olds and three out of 21 7-8-year-olds did not obtain approval for participating in the study. In the UK school, all the children were allowed to participate in the study. Thus, the total number of the participating children was 76. Although the Finnish children obtained approval to participate in the study, they did not obtain approval for providing audio voice examples on the CD that was to be a part of the thesis since such auditory data was regarded as too confidential by the Head Teacher of the Finnish school.

Prior to commencing data collection, the researcher obtained her criminal check from the Criminal Check Bureau in order to be able to perform the experiments on her own with the children in a separate classroom. The teachers, parents and children were informed that the data would be treated with the strictest of confidentiality and in accordance with the guidelines set by the British Educational Research Association (BERA) (www.bera.ac.uk). The participants and their parents were assured that no names were to be revealed to outsiders and none of the data were to be passed on to a third party. They were assured that the data were to be used for the purposes of the current study only.

5.6.7 Procedure for controlled data collection with the participant children

The procedure used for the pilot and the main studies was the same for each group. As mentioned in Section 5.5, observations were conducted once a week at the British school for approximately a month prior to commencing the main data collection. At the Finnish school, observation was conducted for a day prior to the data collection due to time-constraints.

The researcher attended the school in western London during the autumn term of 2005 in order to gather the data for the first group. The first study was treated as the pilot study. The researcher attended this particular school during the autumn term of 2006 in order to collect the data for the second group. In Finland, she attended the school during the second week of November 2006 in order to collect the data for the third and the fourth participant groups.

In the UK, the researcher attended the school during ten school days, as a fewer number of the participating children were able to take part in the study during each day. In Finland, the researcher attended the school on five separate days and collected data for both classes during that time-period. At both schools, during the first day of the data collection once the researcher randomly divided the children into four groups and, then, administered the first to the children. Each group was asked to come to the back of the classroom, at a time, in order for them to fill in the questionnaire with the researcher's assistance. Instructions and clarification were provided for each question prior to the children commencing to fill in the questionnaire. The children were instructed to sit quietly, to think through the questions independently and to answer the questions honestly. It took approximately 15 minutes from the children to fill in the questionnaire. The second questionnaire was filled in by the children during the second day of the fieldwork. The procedure employed with the first questionnaire was replicated with the second questionnaire.

During the third day, the children were asked to fill in the personality inventory. Specific instructions were provided for the inventory. The children were instructed to read each statement carefully and to circle the response that they regarded as most applicable. As with the questionnaires, the children were divided into four groups prior to commencing to fill in the inventory.

During the fourth day, interviews were conducted with the children and the classroom teacher. Each child was taken into a quiet room separately, in a random order. Each child sat on a chair, facing the interviewer. The interview was recorded with a minidisk player. As with the questionnaire, instructions and clarification were provided for each question. The children were instructed to sit quietly, to think through the questions independently and to answer the questions honestly. Each interview was approximately ten minutes long. The children were interviewed in random order, depending on who the classroom teacher decided to send to the interview room. Subsequently, the interviews were transcribed and analysed with the use of NVivo-software and EXCEL-software (see Appendix 1 for examples of interview data).

During the fifth day, the voice recordings were conducted. Each child was taken to a quiet room one at a time. The order of the children was randomly selected. The children were asked to sit by a desk, facing the researcher. A small microphone was attached to the child's shirt, at approximately 5 cm-long distance from the mouth. The recordings were made with a mp3-player, placed on the desk between the child and the researcher.

Prior to commencing the experiment, the children were provided with instruction as to what was going to happen in the experiment. They were informed that they would be asked to perform simple reading, speaking and singing tasks in a set order. Subsequently, the participant was asked to read a pre-selected text passage; to talk spontaneously after being provoked by a picture; and to answer questions regarding their hobbies in a more informal interview (see Appendix 1 for the tasks).

After the speaking tasks, each child was asked to vocalize pitch-glides. The researcher illustrated the pitch-glides by following pre-formulated lines with her finger (see Appendix 1). The pitch-glides consisted of lines traveling from the top of a piece of paper to the bottom of the paper, either as a straight line or as a curve. The children were instructed to follow the line with their voices so that the top of the paper represent high-pitched voice and the bottom of the paper represented low-pitched voice. The pitch-glides were followed by a short song, chosen by each child prior to commencing the experiment. In its total length, each experiment was approximately 20 minutes long.

Subsequently, the voice data were analysed perceptually with the use of the specially-designed voice assessment protocol. Each voice sample was given a rating by three judges. In addition, each child was given a rating for their perceived speaking and singing competency, as stated above. This score was a sum of the ratings given for each item on the assessment protocol (see Appendix 1). Each child was given a score for 13 parameters in speech and the same parameters in singing. A mean score that was the average of the above was formulated separately for speech and for singing, with the scores representing overall voice quality in speech and overall voice quality in singing exhibited by the individual children. The voice data was also analysed acoustically in order to investigate the findings from the perceptual assessment part from the acoustic perspective.

The perceptual assessment ratings were subsequently analysed statistically. Non-parametric tests were used in the analysis since the sizes of the participating groups were relatively small. The questionnaire, interview and personality inventory items were analysed both quantitatively and qualitatively (see Table 5.4 for a summary on the different data collection methods used for the study).

Data Collection Method	Location and participant population	Purpose
Interviews	a) 4 speech and voice clinics; 8 professional speech and voice therapists b) Two schools; 80 7-10 year-old children c) Classroom teachers	a) To explore the current use of singing in therapeutic practice and the perceptions of professional therapists regarding the potential inclusion of singing in their practice b) To investigate the background of the children participating in the experiments c) To verify the findings from the interviews with the children
Questionnaires	a) Electronically with 5 speech and voice therapist b) 2 schools with the 76 children participating in the experiments	a) To pilot the questions for subsequent interviews b) To gather background information for the children
Observation	a) 2 speech and voice therapy clinics; 10 client population and 14 therapists at work b) 2 schools with the 76 children who participated in the experiments	a) To investigate the current practices of therapists in addition to interview-data b) To observe children's vocal functioning and voice use in a variety of settings and tasks during the school day
Empirical voice data	Quiet locations at 2 schools with the 76 participant children	To gather voice recordings in speech and in singing

Table 5.4: Data triangulations and the contribution of each method used in the current study

5.7 Specifically-designed voice assessment protocol

A new perceptual voice assessment protocol was developed for the study, based on the literature review in Chapter Four. The protocol consisted of separate sections for speaking and singing behaviours. None of the already existing perceptual voice assessment protocols considered both vocal behaviours (see Chapter Four). Therefore, a new protocol was formulated for the purposes of the current study. The voice parameters selected for the protocol had been chosen on the basis of the literature review that concerned the existing perceptual voice assessment protocols (see Chapter Four). The voice parameters that were included in the protocol were chosen on frequency-basis (i.e. these particular parameters were found in the majority of the formally-established perceptual voice assessment protocols).

Both the section for speaking and the section for singing consisted of the same 13 voice parameters (see Table 5.5 below and see Appendix 1 for the protocol). Each parameter was rated on a seven cm-long continuous line (i.e. a Visual Analogue Scale). The left end of the line represented 'healthy voice quality' and the right end of the line represented 'unhealthy voice quality'. A mean score that was the average of the above was formulated separately for speech and for singing, each one of which represented the overall voice quality in speech and that in singing for the individual children. The continuous line represents the rating scale, which ranges from 1 to 7 with 1 representing 'healthy' voice quality and 7 representing 'severely unhealthy voice quality. The left end of the line (i.e. 1) represents 'normality of' or 'absence of' the particular voice quality stated in the left. The right end of the line (i.e. 7) represents 'abnormality of' or 'severe degree of' the voice quality stated in the right.

Absence of		**Severe degree of**
Hoarse	______________________	
Breathy	______________________	
Rough	______________________	

Table 5.5: Three parameters as examples from the formulated perceptual voice assessment protocol

5.7.1 Piloting of the protocol

The first version of the protocol was tested during the pilot study. The voice recordings for the pilot study were assessed by three independent judges. Two of the judges were professional speech and language therapists and the third one was the researcher. One of the therapists was located in Croatia and the other one was located in the UK. Each judge listened to the voice recordings with high-quality headphones at their workplaces. CDs were sent by post to the two judges who were resident outside London. The CDs were accompanied by an instruction sheet as to how to conduct the voice assessment task.

The judges were instructed to rate the voice recoding samples with the use of the protocol (see Appendix 1 for the protocol and its instructions). The judges were instructed to place a cross at a perceptually appropriate point on the continuous line for each voice parameter. They were instructed to rate each voice parameter for its quality on this continuum, bearing in mind that the scale ranged from unhealthy quality (right end of the line) to healthy quality (left end of the line). Subsequently, the protocol was analysed quantitatively and qualitatively for its validity and reliability.

5.7.2 Reliability and validity of the assessment protocol

The reliability and the validity of the protocol was tested in order to know whether the newly formulated perceptual voice assessment protocol was an appropriate instrument to be used in the voice assessment tasks in the study. Quantitative analysis was used for testing the reliability of the protocol statistically and qualitative analysis was used in investigating the validity of the protocol.

5.7.3 Inter-judge reliability

The inter-judge reliability was calculated with a non-parametric test (Kendall's Coefficients) (see Table 5.6). The three judges rated the voice recordings perceptually with the use of the specifically-designed voice assessment protocol (see Section 5.16). The continuous lines on the protocol were divided in to a scale ranging from 1 to 7. The ratings were subsequently analysed with SPSS-software, version 14.00.

The hypothesis was that the judges agreed between their ratings. The hypotheses was verified since the result was not significant ($W=0.70$; $p > 0.05$, n.s.) (i.e. their ratings did not differ significantly from one another). Such a finding indicates that the judges agreed in terms of their ratings in both speaking and singing behaviours, implying that the outcome from the assessment when using the new perceptual voice assessment protocol was not reliant on the person performing the assessment.

N	260
Kendall's W(a)	.70
Chi-Square	1.400
df	2
Asymp. Sig.	.497

Table 5.6: Inter-judge reliability

Inter-judge reliability was calculated separately for both speaking and singing behaviours. For both of the vocal behaviours, the results were not significant (i.e. the ratings did not differ significantly between the judges) (for speech: $W=0.183$; $p> 0.05$, n.s.; and for singing $W=0.100$; $p>0.05$, n.s.) (see Table 5.7). Such a finding indicates that the inter-judge reliability was high for voice quality ratings in regard to both speaking and singing behaviours, suggesting that the reliability of the protocol was not dependent on the vocal behaviour in question.

N	260
Kendall's W(a)	.183
Chi-Square	3.657
df	2
Asymp. Sig.	.161

N	260
Kendall's W(a)	.100
Chi-Square	2.000
df	2
Asymp. Sig.	.368

Table 5.7: Inter-judge reliability for voice quality ratings in speaking (left table) and in singing (right table)

Inter-judge reliability was calculated with an additional non-parametric test, which was Repeated-measures ANOVA, in order to expose the findings from the above statistical tests to further investigation. The hypotheses were:

Ho: There were no significant differences between the voice quality ratings performed independently by the three judges.

Hi: There were significant differences between the voice quality ratings performed by the three judges.

The null hypothesis was accepted since the statistical test verified the finding that there were no significant differences between the ratings provided by the three judges ($z=0.874$; $p>0.05$, n.s.) (see Table 5.8). Since none of the statistical tests were significant, the findings indicate that the inter-judge reliability of the new perceptual voice assessment protocol was high. Therefore, the protocol was regarded a reliable instrument in assessing children's voice quality and vocal functioning in regard to both speaking and singing behaviours.

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
rating	.874	1.078	2	.583

Table 5.8: Inter-judge reliability for voice quality ratings in speech and in singing

5.7.4 Reliability of the protocol

In addition to the statistical analyses presented above, a short interview was conducted with each judge (see Appendix 1 for the interview schedule). The objective of the interview was to investigate whether the designed perceptual voice assessment protocol was regarded as reliable and valid in assessing children's overall voice quality and vocal functioning in regard to both speaking and singing behaviours. The first judge was interviewed face-to-face and the second judge was interviewed electronically. With the second judge, electronic interviewing was the only feasible method to be used since the judge was resident in a different country from the researcher.

All of the judges stated that the protocol was reliable. They stated that the protocol was a reliable instrument in voice assessment, as long as proper and appropriate instructions were provided for the judges prior to commencing the rating process. Detailed instructions were regarded as a crucial aspect in order for the raters to approach their rating task appropriately. The judges agreed that, since such detailed instructions were provided to the raters prior to commencing their task, the reliability of the protocol was high (see Appendix 1 for the instructions).

It was also mentioned by both of the judges that there was a general lack of training as to those of perceptual voice assessment on the majority of speech and voice therapy training courses, despite the fact that perceptual voice assessment is continuously exploited in professional practice. Such lack of training may subsequently interfere with the reliability of the outcomes from perceptual voice assessment. However, since detailed instructions were provided for the judges in this particular study and since the inter-judge reliability was found to be high, a lack of training was not seen as a factor interfering with the reliability of using the protocol in the assessment.

5.7.5 Validity of the protocol

As with testing the reliability of the specially-formulated voice assessment protocol, the validity of the protocol was investigated via interviews with the two external judges. The interview were of approximately 10 minutes in length (see Appendix 1 for the interview schedule). The interview with the first judge was conducted face-to-face; with the second judge, it was conducted electronically.

Both of the judges agreed that the protocol was a valid instrument in assessing children's overall voice quality and vocal functioning in regard to both speaking and singing behaviours. The interviewees both stressed the fact that not a great number of formally-established standardised perceptual voice assessment protocols exist. They also stressed that there was no protocol that would consider both speaking and singing behaviours. Both of the judges stated that it was important to take singing into consideration in perceptual voice assessment since sung vocal output could potentially reveal features of the child's voice production that speaking behaviour could not have revealed. Such additional information may be crucial when exploring the causal factors behind a child's vocal distortion and when designing appropriate intervention methods for a child client.

The design of the protocol was regarded as valid, and it was stated to serve its proposed function well. Both of the interviewed judges agreed that continuous lines rather than numbered categories were a more objective and reliable measure in gathering the desired data. They claimed that, in this way, the ratings are less likely to be constraint into too few categories, reducing the likelihood of loosing informative data. A further comment by both judges was that the empty provided in the end of the protocol for any additional comments was extremely useful as it allowed the raters to comment on the voice recordings open-endedly. Such a procedure is likely to help the judges in providing a detailed description on the child's overall voice quality and vocal functioning.

Furthermore, the judges agreed that, in the 7-point-scale, 1 presented extremely healthy voice quality. The judges stated that very few individuals would be administered with such a rating. Therefore, ratings 2 and 3 were regarded as categories representing vocal healthy that a greater number of individuals were likely to obtain. The judges agreed that ratings 4 and 5 represented less healthy voice quality that could potentially develop into a more severe form of distortions and that ratings 6 and 7 represented unhealthy voice quality (i.e. diagnosed voice distortion).

The judges stated that it was appropriate to include the same set of voice parameters in the section concerned with the section for speaking behavior and the section for singing in order to be able to compare the outcomes from the assessment between the two vocal behaviours. Both of the judges agreed that the voice parameters included in the protocol were valid for constructing a detailed overall picture of the child's overall voice quality and vocal functioning in regard to both speaking and singing behaviours. The judges stated that the protocol covered vocal functioning and voice quality comprehensively since it did not focus on speaking specifically but rather on voice in more general terms. One voice parameter (creaky) was added to the protocol after both of the judges commented on the need for including such a parameter in the protocol. Both of the judges stated that children frequently possess such an 'abnormal' voice quality.

5.8 Nature of data analyses

Both quantitative and qualitative approaches were used when analysing the data gathered through the voice quality ratings, interviews, observation and the survey. Since data were gathered via different methods, a mixed analysis was regarded as suitable (Robson, 2002; Tashakkori and Teddlie, 2003). Qualitative analyses as a means for investigating the quality of the data and quantitative analyses as a means for describing the data statistically and make interferences from the data, for presenting the data comprehensively and for addressing the proposed research questions (Denzin and Lincoln, 2007; Mertens, 2005). Both approaches investigate the causal relationships between various variables through different means (Denzin and Lincoln, op.cit.). Such a mixed-method approach in the analyses provided the researcher with comprehensive means for legitimating the findings from the study (Mertens, op.cit.; Tashakkori and Teddlie, op.ci.t).

Qualitative analysis was regarded as an appropriate means for analysing the data gathered via observations since the intension was to record in-depth descriptive data on the particular phenomenon (Payne, 1980). Since the interviews and the questionnaires consisted of open-ended items, both qualitative and quantitative methods were exploited in analysing the data (Robson, 2000). Specific items (such as whether the participants possessed any difficulty with reading) were provided with a score in order to be able to carry out statistical analyses on the data. Data from the experiments were analysed quantitatively with the use of the specially-designed voice assessment protocol (see Section 5.17 for more details).

The use of both quantitative and qualitative approaches in analysing the data minimised potential loss of informative data (Payne, 1980). Such an approach also enabled the researcher to approach the research questions from different perspectives and to analyse the gathered data in depth.

5.9 Research limitations and generalisability of the findings

Particular limitations became evident to the researcher whilst carrying out the study. As with any study relying on data gathered from human participants, specific variables are out of the researcher's control despite various attempts to conduct the study in a systematic manner.

As stated in Chapters Two and Three, a number of factors influence children's overall voice quality and vocal functioning (Thurman and Welch, 2000). Therefore, it may be difficult to point out all the possible factors that simultaneously influence the participants' voices. A number of uncontrolled factors (such as physiological or psychological tiredness) are likely to be influencing the outcome of the study. Nevertheless, conclusions can be drawn from the findings, provided that the potential 'out-of-control-factors' are kept in mind when drawing generalizations from the findings. Moreover, since the focus was on specific factors (such as specific psychological elements), generalizations from the study can be applied to these particular factors.

Furthermore, the nature of the participant population may have complicated the study since children may not always be able to provide focussed and comprehensive answers neither in interview situation nor for the survey (Robson, 2002). In the current study, observations and experiments generated additional data for supplementing data gathered through interviews and the survey. Such a process formulated a reliable and comprehensive data set. Furthermore, interviews with the classroom teachers were used as a means to verify data gathered from the children.

Nevertheless, the 7-10-year-old children were regarded as being old enough to be able to carry out a variety of tasks and to be able to answer relatively challenging questions objectively. In addition, children within this age-range are generally able to self-reflect and provide coherent answers (Harris and Butterworth, 2007). Nevertheless, the question of reliability and validity in regard to the interview and questionnaire questions remains. It should also be noted that the sampling method used limits the freedom to generalize the findings to a larger population (Thomas, 2003). Purposive sampling may not include a full variety of individuals from the general population. Thus, specific individual characteristics may have been left out from the data, complicating the process of drawing generalization from the study.

The main limitation of the experiments was that they were not carried out in naturalistic settings and, thus, the experiment situation may have influenced the outcome of the study despite the fact that the experimental setting was well-designed. The participants may have felt anxious and apprehensive in the experimental situation. This may have subsequently distorted the outcomes of the experiments. However, the experiment location was the school that the children were attending. Therefore, the familiarity of the location may have minimised the experimental- bias (Grbick, 2004). In addition, prior to commencing any data collection, the researcher familiarized herself with the participant children, subsequently minimizing the researcher-disturbance effect (Thomas, 2003).

The main limitation with observation is that, when a person carries out the observation, the issue of researcher's subjectivity evidently has an impact on the outcomes from the study. Despite various attempts to remain objective, a researcher's own ideas and views are reflected in the final outcome of the observations. Moreover, it has been stated that objectivity cannot be fully-captured in any research study (Denzin and Lincoln, 2007).In the current study, the observation sheets had been constructed on the basis of an extensive literature review. Since the researcher followed the observation schedules throughout the observation phases in the study, the focus of the observations was likely to remain objective (Grbick, 2004; Mertens, 2005).

An additional limitation for the study was the potential cultural-bias brought to the study by the judges. The judges may have been biased by their cultural and linguistic backgrounds during their assessment process (Rinta and Welch, 2008b). Therefore, a study with a grater number of judges from a greater variety of backgrounds would need to be conducted in the future, with a specific intention on investigating such a cultural aspect in voice assessment. However, the three judges who performed the perceptual voice assessment in the current study were from three different countries (Croatia, Finland and the UK). Thus, the culture-bias was minimized due to the fact that the judges were originally from different countries.

One major limitation of the study was that small groups of children were used as the participant groups. Therefore, the findings from the study should be generalised with caution (Punch, 2005). In a further study, a larger group-size could potentially allow the researcher to generalise the findings from the study to a wider population. In addition, a longitudinal study consisting of a group undergoing singing training would generate reliable longitudinal data on the effect of singing on children's overall voice quality and vocal functioning. Although the study does not state 'what is what', the exploratory nature of it provides indication as to 'what may be what' and 'what could be what' (Kvale, 1996). The objective of the study was not to generalise the findings to a wider population, but rather to highlight aspects that can investigated be further in subsequent research.

Chapter 6: Physiological perspective

6.1 Introduction

In this Chapter, data for connections between children's speaking and singing behaviours from the physiological perspective are presented. The Chapter illustrates connections between the two vocal behaviours primarily through perceptual voice data. Physiological factors underlying children's vocal functioning and voice quality in both their speaking and singing behaviours are also discussed (see Footnote 1).

This Chapter focusses on data gathered from 76 children that performed as participants in the study. The analyses presented in this Chapter were replicated for four independent small studies that represented separate participant groups (see Chapter 5 for more details on the participants). The intention behind focusing on the large group and the small groups was to investigate whether the findings from this Chapter were verified through the findings from the four small studies or whether any significant differences were recorded between the small groups. Data for the four small groups are presented independently in the Appendices (see Appendices 2-5).

Statistical analyses for the whole group and the small groups were carried out in order to investigate:

- **a)** general trends in voice quality in both speech and singing for the children as a group;
- **b)** voice qualities in speech and singing for individual children;
- **c)** within and between group comparisons in terms of any similarities and differences between voice qualities in speech and singing for children possessing healthier voice quality and those possessing unhealthier voice quality;
- **d)** intra-and inter-group comparisons, as well as analysis within the whole class, between specific voice parameters in speech and in singing.

Foot note 1: The key features of this Chapter were published in Rinta, T. and Welch, G.F. (2008). Perceptual connections between pre-pubertal children's speaking and singing behaviours. *Journal of Voice, 17(2), 100-112*

6.2 Information on participants

The first small-scale study was from a primary school in London (autumn, 2005); the second study was from the same school in the following school year (autumn, 2006); the third study was from a primary school in Finland (10-year-olds, autumn, 2006); and the fourth study was from the same school in Finland with a different age-group (7-8-year-olds, autumn, 2006).

The participants for the first study (London, 2005) consisted of 22 children recruited from one school in inner London (see Appendix 2) (see section 5.9.2 in Chapter 5 for more details on the participating schools). The participants were 9-10-year-olds from Key Stage 5. Of the original 25 participants, full data were available for 22 since 3 children were absent for parts of the data collection and so were not included in the final analyses.

The second study (London, 2006) consisted of 18 children from the same school as the first group (see Appendix 3). The participants were 9-10-year-olds from Key Stage 5 class. The participants for the third study (Finland, 2006, study 1) were 22 children from a school located in greater Helsinki area in Finland (see Appendix 4). The participants were 9-10-year-olds. The participants for the fourth study were 18 children from the same school in greater Helsinki area (Finland, 2006, study 2) (see Section 5.9.2 for more information on the participants) (see Appendix 5). The participants for this group were 7-8-year-olds.

As mentioned above, in this Chapter, 76 participants from the four small independent groups were treated as one group. Prior to commencing the analyses for this Chapter, a non-parametric test was calculated in order to test whether the distributions for the ratings for the small groups were statistically significantly similar to on another. The test was not significant (p.0.05), therefore, it was appropriate to treated participants from the four small groups as one large group (see Footnote 2).

Footnote 2: Kruskal-wallis non-parametric test for investigating whether there was a statically significant difference between the overall voice quality ratings of the four small groups.

	sp1	sp2	sp3	sp4
Chi-Square	3.000	.000	.000	3.000
df	3	3	3	3
Asymp. Sig.	.392	1.000	1.000	.392

6.3 Voice quality ratings

Firstly, overall voice quality ratings in speech and those in singing were compared for the whole group. Descriptive statistics demonstrated that there was a minimal difference between overall voice quality ratings in speech and those in singing (see Table 6.1 and Figure 6.1 below). The mean rating for speech was 1.95 compared to 1.69 in singing. The standard deviation was greater for speech than for singing (0.823 versus 0.589). The range for the ratings varied by 2.90 points for speech (1.00-2.90) and by 2.20 for singing (1.00-2.20) (see Table 6.1 and Figure 6.2) (see Footnote 3a).

Group	Speech			Singing		
	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Whole group (N=76)	1.95	0.823	2.90	1.69	0.589	2.20

Table 6.1: Descriptive statistics for voice quality scores in speech and in singing where 1=healthy, 2=healthy, 3=healthy, 4=less healthy, 5=less healthy, 6=unhealthy, 7=extremely unhealthy (colours indicate three broad categories of vocal healthy, evidence of some vocal problem, or more extreme unhealthy voice use)

The findings imply that there was minimal difference between overall voice quality ratings in speech and those in singing for the whole group. The findings also indicate that overall voice quality for the whole group was slightly healthier in singing than in speech. Nevertheless, overall quality for both vocal behaviours for the majority of the participants fell within the category of healthy voice quality (i.e. ratings 1-3). The ratings for subset of the children (N=13) fell within the category of less healthy voice quality (i.e. 4-5) in either or both of the vocal behaviours. The findings were verified by separate analyses for the four small studies that supported the finding that there was a tendency for voice quality in one vocal behaviour to be associated with similar in the other behaviour (see Footnote 3b) (see Appendices 2-5). In addition, the findings from the small studies supported the claim that overall voice quality tended to be healthier in singing than in speech, with minimal difference being recoded between the two vocal behaviours (see Appendices 2-5).

Footnote 3:

a) The ratings for the perceptual analyses clustered between 2 and 3 on the 7-point scale. 1 was perceived as extremely healthy, and 2-3 healthy, with very few individuals scoring 1 due to the fact that such perceptual voice quality is uncommon. Therefore, ratings 1-3 were treated as healthy and 'normal', ratings between 4 and 5 as less healthy and 'normal' and ratings 6-7 as unhealthy and 'abnormal'.

b) a) Group 1= mean for speech: 3.99 and mean for singing: 3.83; b) Group 2= mean for speech: 2.13 and mean for singing: 1.75; c) Group 3: mean for speech = 2.23 and mean for singing: 1.88; d) Group 4: mean for speech: 1.31 and mean for singing: 1.30.

When looking at individual children, overall voice quality was perceived as healthier in singing than in speech for the majority of the children (healthier overall voice quality in singing than in speech for 43 children; healthier overall voice quality in speech than in singing for 22 children; equally healthy overall voice quality in both behaviours for 11 children). Nevertheless, the differences between ratings for speech and singing were minimal for the majority of the children, as indicated above. The bar chart below illustrates the findings (see Figure 6.1).

Overall voice quality in speech and overall voice quality in singing for individual participants

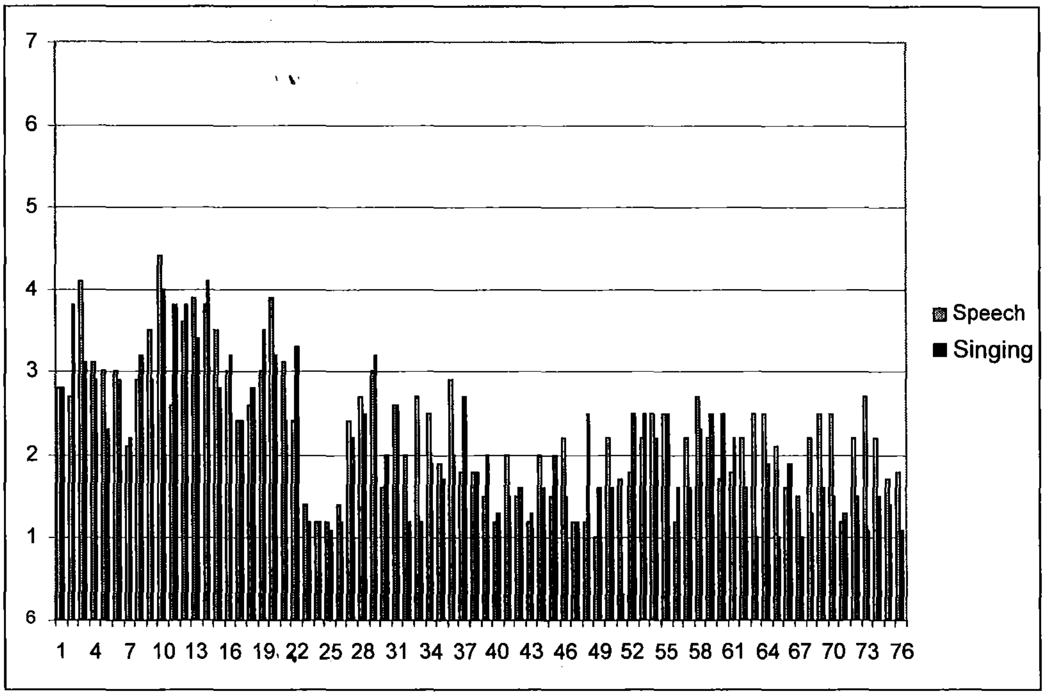


Figure 6.1: Column-chart for overall voice quality ratings in speech and in singing for individual participants

When the overall voice quality ratings were rank-ordered for speech and for singing, minimal differences were recorded between the distributions (see Figure 6.2). Both of the distributions were positively skewed. For speech, the skewness distribution was 1.038. For singing, the skewness distribution was 1.084. The findings from the four small studies verified the findings that there were minimal differences recorded between the distributions, with the distribution for the singing ratings being more positively skewed than the distribution for the speech ratings (Group 1 = speech: -0.288 and singing: 0.282; Group 2 = speech: 0.50 and singing: 0.59; Group 3 = speech: 0.460 and singing: 1.353; Group 4 = speech: 0.676 and singing: 0.466) (see Appendices 2-5).

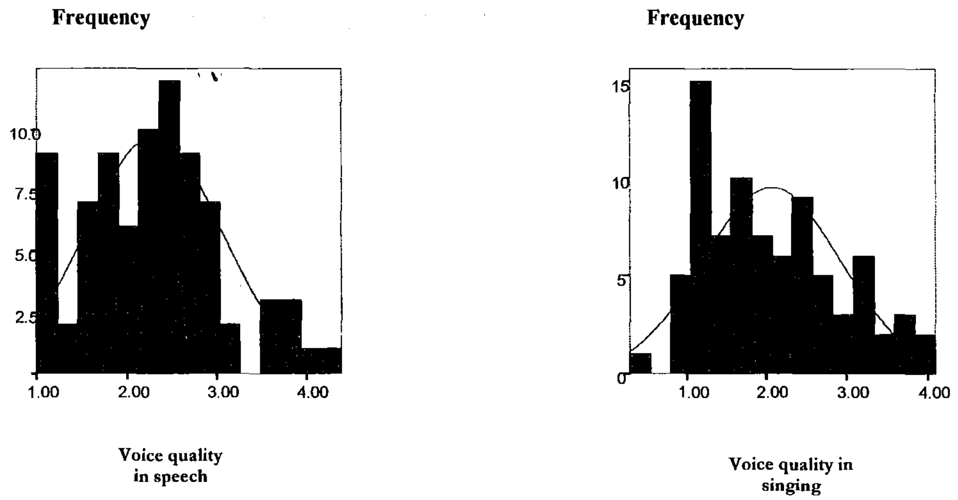


Figure 6.2: Distribution of rank-ordered voice quality ratings in speech (left figure) and in singing (right figure) for the whole group

The scatterplot below (see Figure 6.3) illustrates the non-parametric correlation between overall voice quality ratings in speech and those in singing for the whole group. The plot indicates a moderately strong positive correlation, which verifies the findings from the non-parametric tests for the tendency of voice quality in one vocal behaviour to be associated with similar quality in the other ($r=0.625$; $p<0.05$) (see Table 1 in Appendix 1) (see Footnote 3). The plot also illustrates that there were no obvious outliers within the voice quality ratings. The findings were verified in the four small studies (Group 1: $r=0.589$, $p<0.05$; Group 2: $r= 0.766$, $p<0.05$; Group 3: $r= 0.519$, $p<0.05$; Group 4: $r=0.655$, $p<0.05$) (see Appendices 2-5).

Footnote 3: Non-parametric analyses were used since the distribution of the ratings was skewed towards unhealthy quality and, thus, a normal distribution was not assumed for the ratings (Robson, 2000).

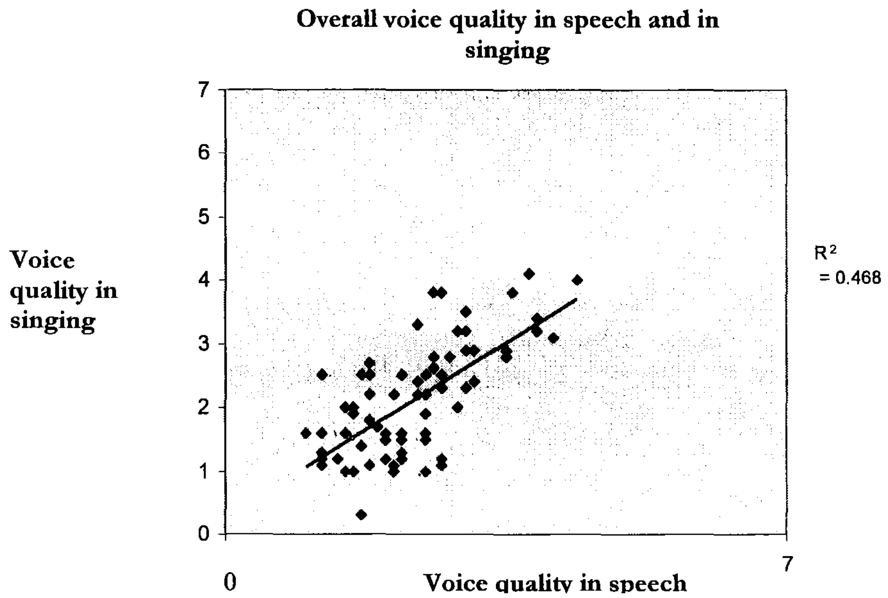


Figure 6.3: Relationship between overall voice quality ratings in speech and those in singing for the whole class

The mode, median and standard deviations were calculated for each individual voice parameter in speech and for those in singing in order to investigate whether the mean ratings were a reliable measure for exploring and representing the gathered voice data (see Figure 6.4). The finding was that the non-parametric correlations between each measure in speech and in singing were statistically significant (mode: $r=0.489$; $p<0.05$; median: $r=0.851$; $p<0.05$; standard deviation: $r=0.353$; $p<0.05$) (see Tables 2-4 in Appendix 1). The correlations were positive and relatively strong. The findings were supported by the four small studies (see Footnote 4) (see Appendices 2-5). This indicates that the mean ratings were an appropriate tool in analysing the voice data.

Footnote 4: a) Group 1= mode: $r=0.587$, $p<0.05$; median: $r=0.851$, p,0.05, s.dev.: $r=0.617$; b) Group 2= mode: $r=0.853$; $p<0.05$; median: $r=0.851$; $p<0.05$; standard deviation: $r=0.353$; $p<0.05$; c) Group 3= mode: $r=0.587$; $p<0.05$; median: $r=0.851$; $p<0.05$; standard deviation: $r=0.617$; $p<0.05$; d) Group 4= mode: $r=0.537$; $p<0.05$; median: $r=0.721$; $p<0.05$; standard deviation: $r=0.331$; $p<0.05$

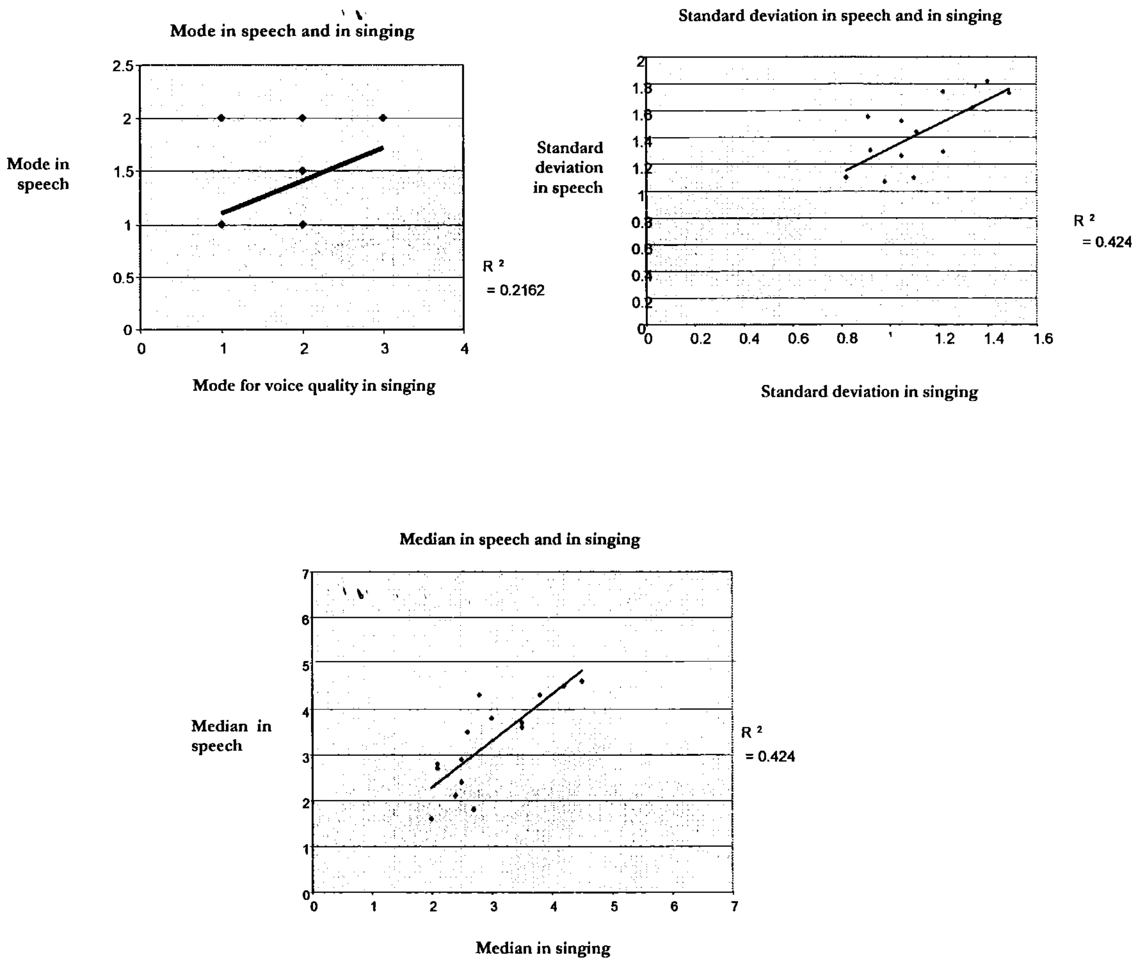


Figure 6.4: Scatterlpots for: mode for voice quality in speech and voice quality in singing for the whole class (left figure on top corner); median for voice quality in speech and voice quality in singing for the whole class (right figure top right corner); and standard deviation in speech and in singing (lower figure)

6.4 Voice parameters in speech and in singing

In addition to investigating the relationship between the mean ratings in speech and those in singing, non-parametric tests were calculated in order to investigate whether the same results were found when comparing the ratings for each voice parameter in speech to those in singing rather than the mean scores for overall voice quality in both behaviours. The result was not significant ($p>0.05$, n.s.) (see Table 5 in Appendix 1). Therefore, the findings indicate that the perceptual quality of individual voice parameters did not differ significantly from speaking behaviour to singing behaviour. The four small studies supported the findings by illustrating that there was a tendency for the quality to be similar between the two vocal behaviours ($p < 0.05$) (see Appendices 2-5).

Voice quality in speech was compared to voice quality in singing for each child separately through taking individual voice parameters into consideration as opposed to the mean ratings. A non-parametric test was conducted for each child (see Footnote 5) (see Appendic-5). The test was statistically significant ($p<0.05$) for the majority of the children (N=68), indicating that the ratings in each parameter in speech were similar to those in singing. The findings, therefore, suggested that there was a tendency for voice quality in each voice parameter in speech to be similar to their quality in singing.

6.5 General impression and detail of voice quality

General trends and specific details within the voice quality ratings were explored. Mean ratings of each parameter, general trends within the mean ratings and the distribution of the ratings for each individual child were investigated.

6.5.1 Rating of the parameters

On a 7-point scale, ratings from 6 to 7 were treated as unhealthy voice quality, whilst ratings from 1 to 3 were treated as healthy voice quality following discussion with members of the assessment panel who were professional speech therapists and the ratings from 4 to 5 as less healthy. The voice ratings clustered around 4.0 for both speech and singing, indicating that a significant number of the children (N=52) possessed somewhat unhealthier voice quality. Due to the nature of the distribution of the ratings children with ratings between 6 and 7 were referred to as those possessing voice disorders in subsequent analyses.

Footnote 5: The non-parametric test was not significant ($p>0.05$, n.s.) for the majority of the children (N=68). The finding implies that the quality of the children's voices in their speaking behaviour was similar to the quality of their voices in their singing behaviours

It should be noted that the judges may not have been equally sensitive to all voice parameters, which may have biased their rating outcomes. For example, hoarse and rough voice qualities are the most common voice distortions amongst children, potentially biasing the judges' to perceive such distortions easier than other distortions (see Chapter Three). Nevertheless, when looking at the ratings by the three judges, they seemed to have been consistent in their ratings, with the inter-judge reliability being high (for speech: $W=0.183$; $p> 0.05$, n.s.; and for singing $W=0.100$; $p>0.05$, n.s.) (see Section 5.17 in Chapter Five).

6.5.2 Individual voice parameters and their relationship to overall perceived voice quality

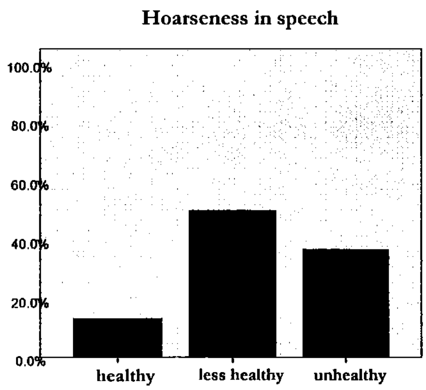
The ratings for different voice parameters for individual children were looked at in more detail in order to investigate (i) whether any specific voice parameters seemed to be the primary influences on the overall quality of the children's voice and (ii) whether the means were an appropriate tool in comparing the children's voice quality characteristics in speech to those in singing.

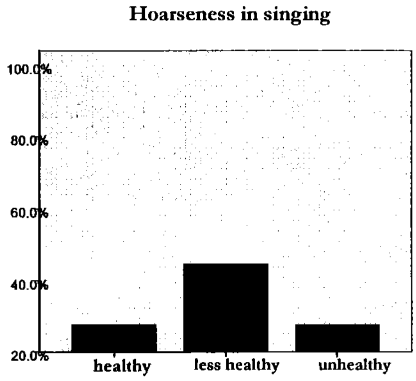
With regard to unhealthy voice quality, hoarseness was perceived as the unhealthiest voice parameter (that is, it had the highest ratings) in both speech and singing (see Tables 6.2 and 6.3; see Figure 6.5). For approximately 80 percent of the children, their voice quality was distinctively hoarse in both their speaking and singing behaviours. Breathiness was perceived as unhealthy or less healthy in speech and in singing for approximately 70 percent of the children. Vocal fry was perceived as unhealthy or less healthy for approximately 60 percent of the children with reference to both vocal behaviours. Roughness was perceived as unhealthy or less healthy for approximately 50 percent of the children in both vocal behaviours. With regard to healthy voice quality, hyponasality and hypofunctioning were perceived as the healthiest parameters in both speech and singing for all the children (95.6% healthy in speech and 90.1% healthy in singing).

Nevertheless, there were no statistically significant differences between the distributions of the ratings for each of the 13 parameters (Kruskal-Wallis: z=0.644; p>0.05, n.s). The findings were verified in the four small studies that indicated similar general trends amongst the voice

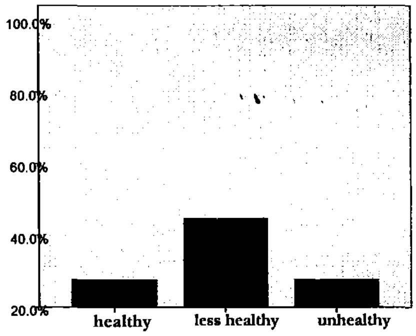
Voice parameter	Speech	Singing
Hoarse	50% less healthy; 36.4% unhealthy	45.5% less healthy; 27.3% unhealthy
Breathy	45.5% less healthy; 27.3% unhealthy	31.8% less healthy, 27.3% unhealthy
Vocal fry	36.4% less healthy, 31.8% unhealthy	36.4% less healthy; 36.4% unhealthy
Rough	13.6% less healthy; 45.5% unhealthy	31.8% less healthy, 22.7% unhealthy
Hyponasal	95.6% healthy	90.1% healthy
Hypofunctional	95.6% healthy	90.1% healthy

Table 6.2: Percentages for unhealthy and healthy voice quality characteristics in speech and in singing for those voice parameters that were rated as the healthiest and the unhealthiest ones

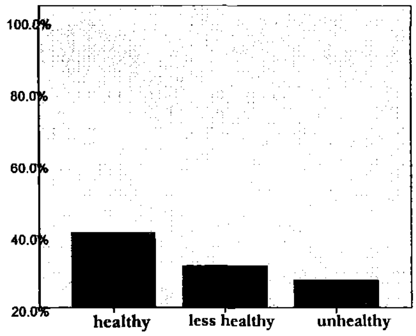




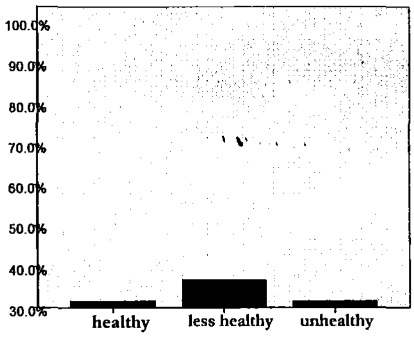
Breathiness in speech



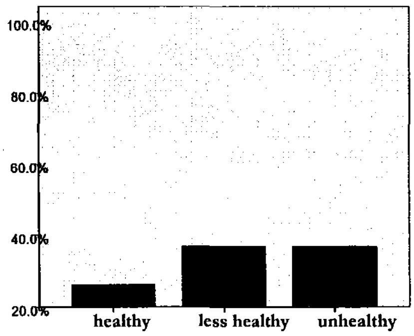
Breathiness in singing



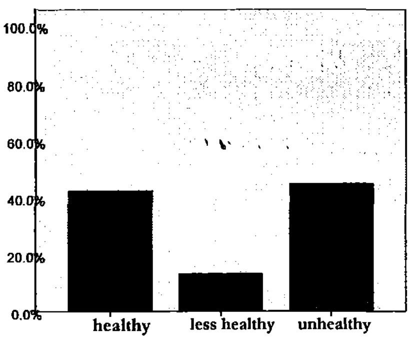
Vocal fry in speech



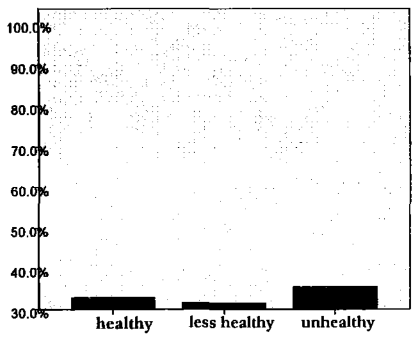
Vocal fry in singing



Roughness in speech



Roughness in singing



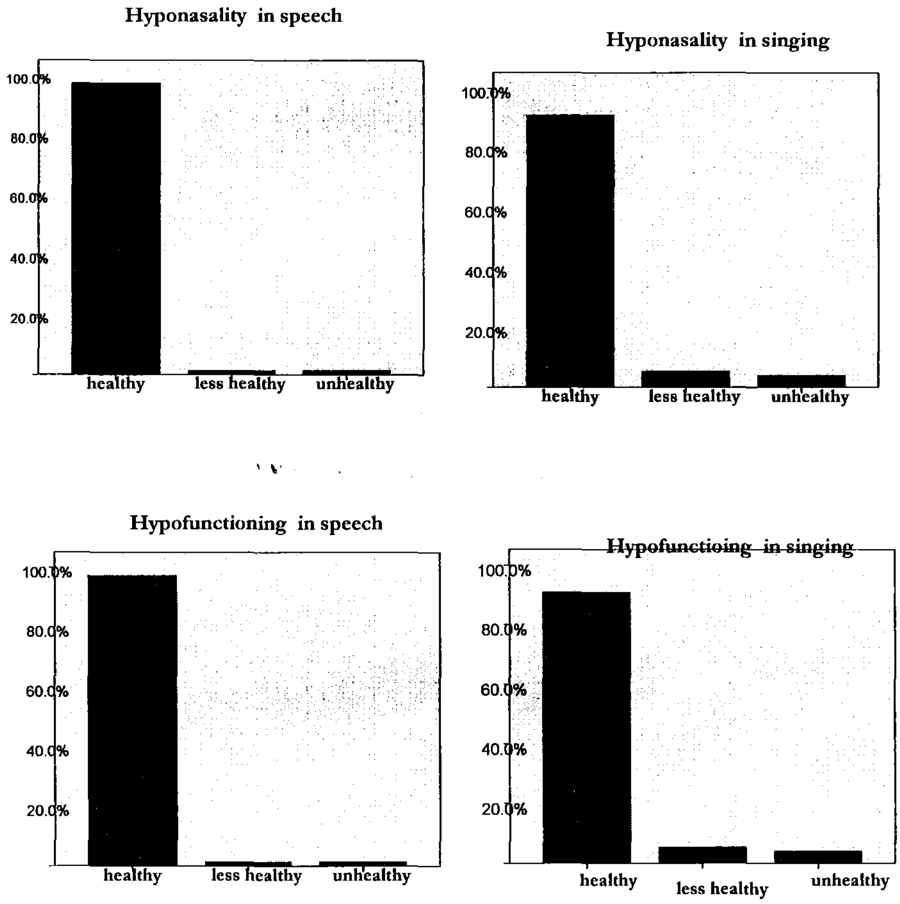


Figure 6.5: Bar-charts for healthy, less healthy and unhealthy voice quality categories for speech and singing

It became evident that the ratings between speech and singing differed minimally when the ratings for individual voice parameters were rank-ordered (see Table 6.3). The greatest difference recorded between an overall rating in speech and that in singing was 0.5, which was recorded in the parameters of hyperfunctional, hypofunctional and voice gratings. For the first two parameters, the qualities were perceived as healthier in singing than in speech. For the latter parameter, the quality was perceived as healthier in speech than in singing.

Nevertheless, the findings indicate that there were no major differences recorded between the ratings for individual voice parameters in speech and those in singing. The findings were supported by the four small studies that also demonstrated that there were no major differences between the ratings obtained for the different voice parameters (see Footnote 6) (see Appendices 2-5).

Voice parameter	Mean rating in speech	Mean rating in singing
Hoarse	3.2	2.8
Breathy	2.9	2.5
Vocal fry	2.3	2.4
Rough	2.6	2.5
Hyponasal	1.4	1.3
Hypofunctional	2.1	1.6

Table 6.3: Rank-ordered voice parameters perceived at the extremes on the rating-scale

Footnote 6: **a**) *Group 1*= greatest difference in vocal fry (1.4 points higher in singing than in speech), hypofunction (0.7 points higher in speech than in singing) and voice gratings (0.9 points higher in singing than in speech).; **b)** *Group 2*= greatest difference in vocal fry (1.4 points higher in singing than in speech), hypofunction (0.7 points higher in speech than in singing) and gratings (0.9 points higher in singing than in speech); **c)** *Group 3*= greatest difference in voice breaks (1.0 points higher in singing than in speech) and hyperfuntion (0.7 pints higher in speech than in singing); **d)** *Group 4*= Greatest difference in: audible inhalation (0.9 points higher in singing than in speech); voice breaks (0.9 points higher in speech than in singing); and hypofunction (0.8 points higher in singing than in speech).

The radar-charts (see Figure 6.6) display the above findings as a composite. The charts illustrate the mean ratings for each individual voice parameter and, subsequently, highlight the perceptually healthiest and the unhealthiest voice parameters. The radars also illustrate the fact that there were only minimal perceptual differences between the mean ratings for the individual voice parameters in regard to the two vocal behaviours. The charts also illustrate that there was greater variation amongst the voice quality ratings in singing than those in speech. The findings were verified in the four small studies (see Appendices 2-5).

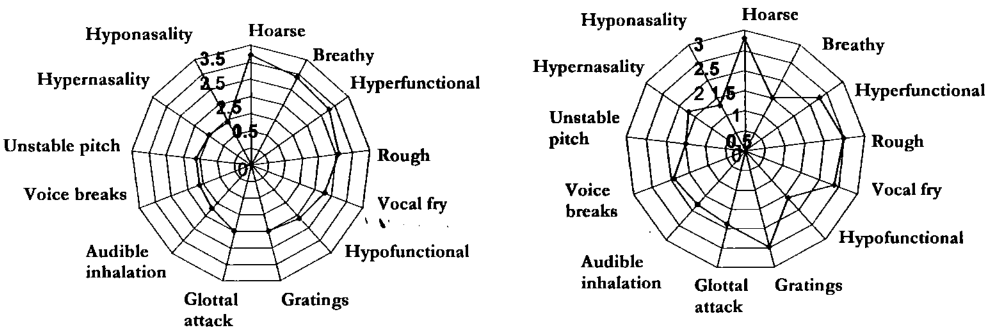


Figure 6.6: Radar-charts for the mean ratings in speech for individual voice parameters (left figure) and those in singing for individual voice parameters (right figure) for the whole class

6.6 Individual differences

General trends were recorded across the children with regard to perceptually unhealthy or less healthy individual voice parameters. Therefore, the healthiest and the unhealthiest voice parameters were looked at in more detail in reference to both speaking and singing behaviours.

6.6.1 Unhealthy characteristics

When looking at the distribution of voice quality ratings for each individual child in terms of their voice quality in speech (see Figure 6.7 below and Figures 2.9, 3.5, 4.6 and

5.6 in Appendices 2-5), hoarseness was rated relatively highly on the scale, implying unhealthy or less healthy voice quality for 61.8 percent of the children. Hyperfunctioning was also rated relatively highly on the scale, indicating unhealthy or less healthy voice quality for 34.2 percent of the children, whilst breathy voice quality was rated as unhealthy or less healthy for 32.9 percent of the children. In addition, roughness was rated as unhealthy or less healthy for 17.1 percent of the children. Therefore, the ratings for these specific parameters biased the mean ratings of these particular children's overall voice quality towards unhealthy quality.

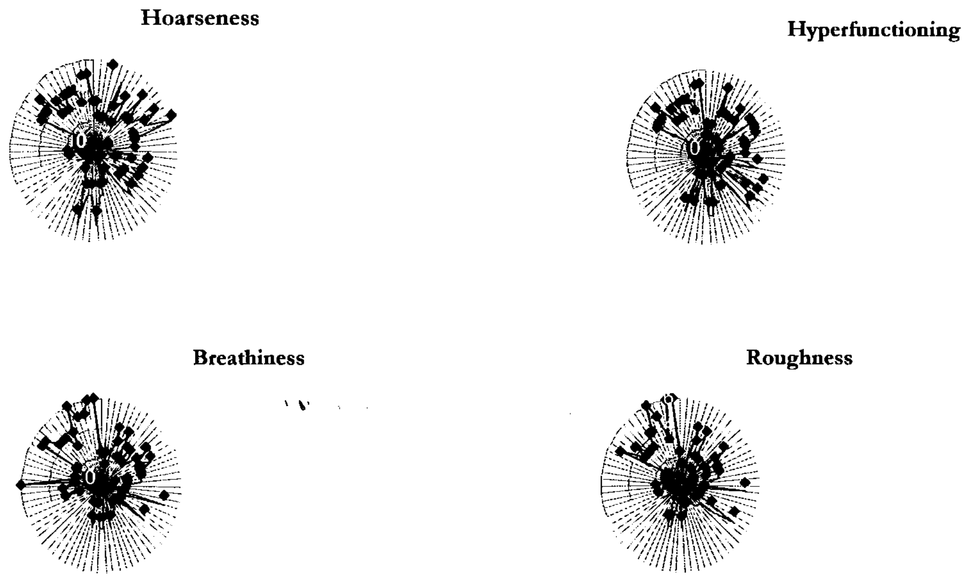


Figure 6.7: Composite radar-charts for voice quality rating for separate voice parameters in speech for all participants: hoarse (top left figure); hyperfunction (top right figure); breathiness (lower left figure); and roughness (lower right figure) (inner part of each figure represent healthy voice quality and outer part for each figure represents unhealthy voice quality on the 7-point scale)

When looking at the distribution of the voice quality ratings in singing (see Figure 6.8 below; Figures 2.9, 3.5, 4.6 and 5.6 in Appendices 2-5), hoarseness was rated as unhealthy or less healthy for 35.5 percent of the children. Breathy voice quality was rated as unhealthy or less healthy for 23.7 percent of the children, whilst unstable pitch was perceived as unhealthy or less healthy for 17.1 percent of the children. Therefore, the ratings for these particular parameters biased the mean ratings obtained for these children's overall voice quality towards healthy quality.

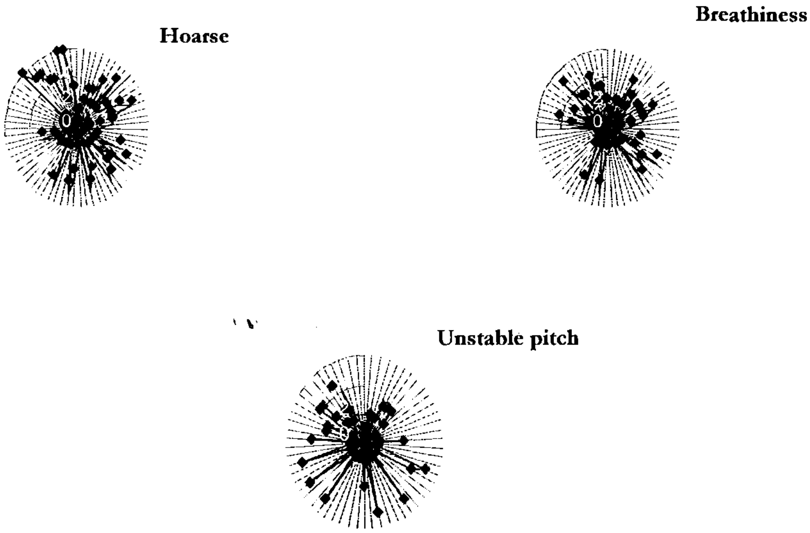


Figure 6.8: Composite radar-charts for voice quality rating for separate voice parameters in singing for all participants: hoarse (top left figure); breathiness (top right figure); and unstable pitch (lower figure) (inner part of each figure represent healthy voice quality and outer part of each figure represents unhealthy voice quality on the 7-point scale)

6.6.2 Healthy characteristics

When looking at the distribution of the ratings in speech for individual voice parameters (see Figure 6.9 see Figures 2.9, 3.5, 4.6 and 5.6 in Appendices 2-5), voice-breaks and unstable pitch were perceived as healthy for 72.5 percent of the children. Hypofunctioning and hyponasality were perceived as healthy for 50 percent of the children in speech. Thus, these specific voice parameters biased the children's overall voice quality in speech towards perceptually healthy quality.

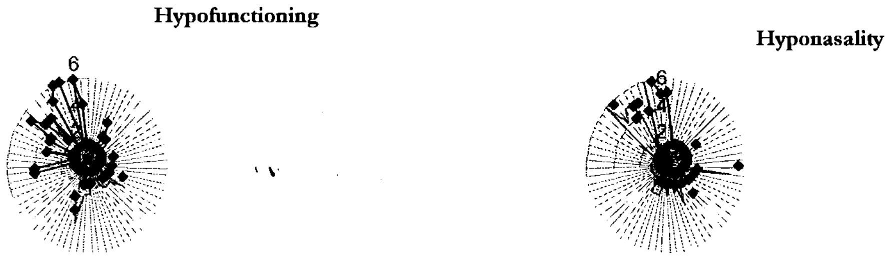


Figure 6.9: Composite radar-charts for healthy voice quality rating for separate voice parameters in speech for individual children: hypofunctioning (left figure); and hyponasality (right figure) (inner part of each figure represent healthy voice quality and outer part of each figure represents unhealthy voice quality on the 7-point scale)

In singing, voice-breaks were rated as relatively absent for 69.7 percent of the children (see Figure 6.10 below; see Figures 2.9, 3.5, 4.6 and 5.6 in Appendices 2-5). Hyponasality was perceived as healthy for 65.7 percent of the children, whilst hypofunctioning was perceived as healthy for 50.0 percent of the children. Thus, these specific voice parameters biased the children's voice quality in singing towards perceptually healthy quality.

Hypofunctioning

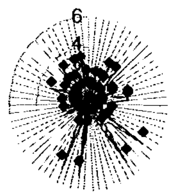


Figure 6.10: Composite radar-charts for healthy voice quality rating for separate voice parameters in singing for individual children: voice-breaks (top left figure); hyponasality (top right figure); hypofunctioning (lower figure) (inner part of each figure represent healthy voice quality and outer part of each figure represents unhealthy voice quality on the 7-point scale)

It should be noted that a significant number of the mean voice quality ratings for each voice parameter fell within the range of 1.0 and 3.0, indicating healthy overall voice quality. A minimal number of the ratings fell within the range of 4.0 and 5.0. Only one rating for hoarseness in speech fell above 5.0. The findings, therefore, indicate that the individual voice parameters rated as the unhealthiest and the healthiest (as indicated above) considerably contributed towards the children's overall voice quality and influenced the listener's general impression of the child's voice.

6.7 Relationships between different voice parameters

Non-parametric correlations between independent voice parameters were calculated in order to investigate whether unhealthy voice quality in specific parameters correlated with unhealthy quality in any other parameter. The correlations were calculated between each of the 13 parameters in speech and in singing, separately.

In both speech and singing, statistically significant correlations were found between: hoarseness and hyperfunctioning ($r=0.603$, $p<0.05$); hyperfunctioning and breathiness ($r=0.420$, $p<0.05$); hoarseness and roughness ($r=0.496$, $p<0.05$); roughness and hyperfunctioning ($r=0.611$, $p<0.05$); and hyperfunctioning and voice gratings ($r=0.422$, $p<0.05$) (see Figure 6.11 below; see Tables 6-10 in Appendix 1). The findings imply that there is a statistically significant relationship between the represented voice qualities. For example, when a child's voice is perceived as possessing a breathy quality in their speaking behaviour, the child's vocal functioning is likely to be perceived as hyperfunctional in speaking (and vice versa). The findings were verified in the four small studies that indicated that relationships were recorded between specific voice parameters (see Appendices 2-5). It should be noted that the statistically significant relationships varied from group to group, indicating that a further study is needed in order to be able to draw firm conclusions from the present findings (see Chapter 11).

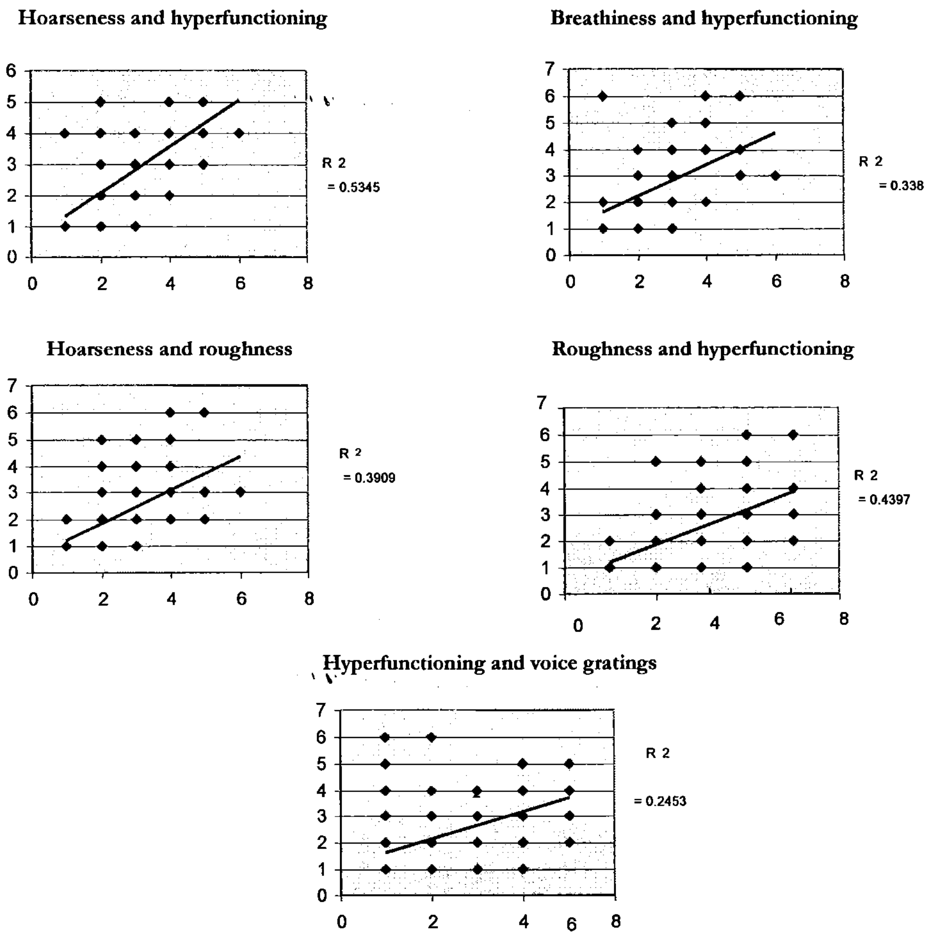


Figure 6.11: Scatterplots for hoarse and hyperfunctional voice qualities (top left figure); hyperfunctional and breathy voice qualities (top right figure); hoarse and rough voice qualities (left middle figure); rough and hyperfunctional voice qualities (middle right figure); and hyperfunctioning and voice gratings

6.8 Physiological correlates for vocal distortions

As mentioned in Section 6.1, the intention of this Chapter was to present data on connections between children's speaking and singing behaviors from the physiological perspective. The voice-scientific view was adopted as the main focus for the physiological perspective (see Section 6.2-6.7 above). Such a focus was selected since the main interest was to explore voice characteristics and vocal elements that were similar between the two vocal behaviours. Examining specific physiological mechanisms was not regarded as feasible due to the fact that such an investigation requires a considerable amount of time, expertise knowledge and specific equipment. Furthermore, significant ethical issues would have needed to be addressed when attempting to conduct such a physiological examination and, due to time-constraints, it was not feasible to pursue such ethical approval.

Nevertheless, the findings from the interviews with children implied that physiological mechanisms underlie children's speaking and singing behaviours. A significant number of the children (N=41) stated that the same physiological elements generate both their speaking and singing behaviours. Such perceptions indicated that the same physiological mechanisms underlie both vocal behaviors. Responses from a significant number of the participant children (N=45) implied that physiological factors were regarded as playing an important role in voice production process with reference to both speaking and singing behaviours. The children who advocated the idea that physiological mechanisms underlie their voice production process stated that specific physiological mechanisms (such as the mouth and the tongue) generated their speaking and singing behaviours (see Chapter 8 for more details). Such statements imply that there was a consensus amongst the children as to the physiological elements that underlie their voice production process in both vocal behaviours.

Furthermore, the children's subjective opinions on the physiological correlates varied according to their voice quality and their vocal functioning, as well as according to their biographic perceptions of their voices. Children with unhealthy voice quality (N=17) often reported feelings of discomfort and tension in their voice mechanism during voice production (such as tension in the throat), whilst children with healthy voice quality (N=21) did not report such negative feelings (see Chapter 8 for more details).

Although the participant children's subjective experiences indicated that the same physiological mechanisms generate their speaking and singing behaviours, specific physiological factors need to be exposed to a systematic medical examination in order to be able to draw firm conclusions as to indicative physiological correlates between the two vocal behaviours. The findings from the current study only provide implications for potential connections between physiological mechanisms underlying the two vocal behaviours.

6.9 Summary

The findings for the physiological perspective can be summarised as follows:

a) The participant children's perceptual voice quality and vocal functioning were statistically significantly similar in their speaking and singing behaviours with regard to overall voice quality, as well as to independent voice parameters.

b) The perceptual voice quality ratings were slightly healthier for singing behaviour than for speaking behaviour.

c) A greater number of voice quality ratings in singing fell within the range of healthy vocal functioning and voice quality than those in speech.

d) Hoarseness, breathiness, roughness, hyperfunctioning and vocal fry were perceived as the unhealthiest voice parameters in both speech and in singing.

e) Hyponasality and hypofunctioning were perceived as the healthiest voice parameters in both vocal behaviours.

f) Statistically significant relationships were recorded between: hoarseness and hyperfunctioning; breathiness and hyperfunctioning; hoarseness and roughness; roughness and hyperfunctioning; and hyperfunctioning and voice gratings.

g) Implications for underlying physiological correlates between children's speaking and singing behaviours were found, but no definite findings for such factors were gathered.

Chapter 7: Findings from the vocal developmental perspective

7.1 Introduction

In this Chapter, findings from the vocal development perspective are presented for the whole participant population (N=76). The intention was to investigate whether the perceived levels of speaking competency formed a significant relationship with:

a) voice quality and vocal functioning in speech
b) voice quality and vocal functioning in singing .

Similarly, the intention was to investigate whether perceived singing competency formed a significant relationship with:

c) voice quality and vocal functioning in speech
d) voice quality and vocal functioning in singing .

Data for possible relationships between the children's perceived competencies in their speaking and singing behaviours, as well as their vocal functioning and voice quality in both vocal behaviours, are presented. Findings from the four small studies (see Appendices 2-5) are referred to in order to explore how these relate to the findings in this Chapter.

7.2 Perceived speaking competency and overall voice quality

The participant children's perceived speaking competency was assessed on the National Test for Oral and Speaking Competency regularly used at primary schools in England when assessing children's fluency in speaking (see section 5.6.4 in Chapter Five for more details). As indicated by the test, each child was provided with a score that ranged from 7 to 63 on a seven-point-scale (see Appendix 1 for the protocol).

Statistical analyses were carried out between speaking competency ratings meaned across judges and voice quality ratings for all the participants as one large group. Non-parametric correlations were calculated between the perceived competencies and: a) overall voice quality in speech; b) overall voice quality in singing; c) ratings for individual voice parameters in speech; and d) ratings for individual voice parameters in singing.

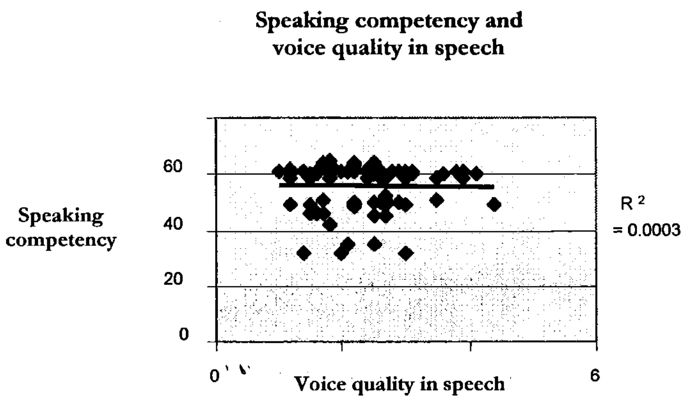
As indicated in Chapter 6, specific voice parameters were perceived to be dominant forms of voice distortions amongst the participant children (see Section 6.5.2). Relationships between these particular parameters and speaking competency were investigated in addition to the relationship between overall voice quality in speech and speaking competency. Focussing on the overall voice quality in speech may have inhibited one from finding statistically significant relationships between specific voice parameters and the perceived level of speaking competency. Thus, the potential relationships between the individual voice parameters and the perceived level of speaking competency were investigated.

When working at the detailed sub-categories of voice quality, the non-parametric statistical tests were statistically significant for hoarseness ($x_2 = 0.015$, $p<0.05$); breathiness ($x_2 = 0.083$, $p<0.05$) and roughness ($x_2 = 0.026$, $p<0.05$) (see Table 11 in Appendix 1). These particular parameters had also been perceived as dominant forms of voice distortions (see Chapter 6). The underlying reasons for the statistically significant relationships are not clear and will be discussed in Chapter 10.

The non-parametric statistical measures between perceived speaking competency ratings and the remaining nine individual voice parameters in speech (i.e. hyperfunctional, voice gratings, unstable pitch, voice-breaks, hard glottal attack, vocal fry, audible inhalation, hypernasality, hyponasality) were not statistically significant, implying that the level of the children's speaking competency did not statistically significantly correlate with the quality of the individual voice parameters in speech (Kruswall Wallace = $p>0.05$, n.s.) (see Tables 11 and 12 in Appendix 1). The correlations between perceived speaking competency and the ratings for individual voice parameters in singing were not statistically significant for any of the parameters ($p>0.05$) (see Table 12 in the Appendix 1).

The correlation between perceived speaking competency and overall voice quality in speech was not statistically significant (r= -0.54, n.s.) (see Table 13 in Appendix 1). The correlation was negative and weak. The correlation between perceived speaking competency and overall voice quality in singing was not statistically significant either (r= 0.003, n.s.) (see Table 14 in Appendix 1). The correlation was also positive and weak. The findings imply that the level of children's perceived speaking competency and their fluency in speaking do not necessarily relate to the overall quality of children's voice in either vocal behaviour (see Figure 7.1).

These findings were verified in each of the four small studies (see Appendices 2-5), with the exception of Study 1 where there was some evidence of a correlation, with reference to singing competency (see Appendix 2). However, this finding was not supported by the other small studies, including Study 2 involving similar children in the same school.



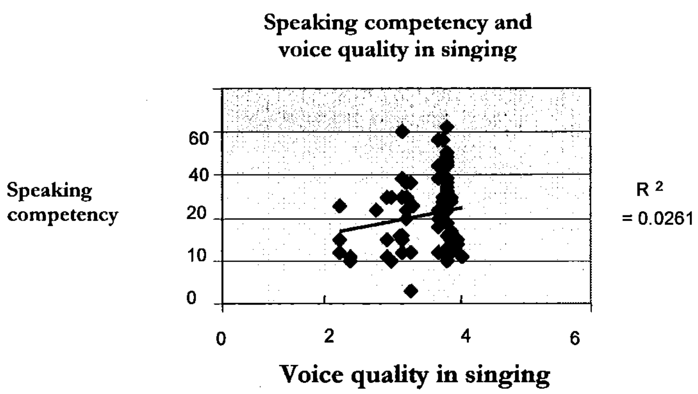


Figure 7.1: Scatterplots for perceived speaking competency and overall voice quality in speech (top figure) and overall voice quality in singing (lower figure)

The potential relationship between overall voice quality and perceived speaking competency was further investigated with two sub-groups. The first group consisted of those children with healthy overall voice quality (i.e. ratings 1-2) and the second group consisted of children with unhealthy overall voice quality (i.e. ratings 6-7) in order to explore whether ratings in the extremes of the scale generated statistically significant results. The relations were insignificant for both groups ($p > 0.05$, n.s.) (see Tables 15-18 in Appendix 1). The finding implies that perceived speaking competency was not related to overall voice quality in speech for any of the participants.

The findings, therefore, imply that the level of children's speaking competency may have related to the quality of specific voice parameters in speech (i.e. hoarseness and unstable pitch), but not to overall voice quality in speech or singing, nor the ratings for individual voice parameters in singing.

7.3 Perceived singing competency and overall voice quality

The participant children's perceived singing competency was assessed on the specially-designed singing competency assessment protocol (see section 5.6.4 in Chapter Five for more details). As indicated by the test, each child was provided with a score that represented their singing competency. The ratings ranged from 7 to 70 on a seven-point-scale (see Appendix 1 for the protocol). Statistical analyses were conducted between the competency scores and the voice quality ratings in both speech and singing.

Statistical analyses were carried out between singing competency ratings meaned across judges and voice quality ratings for all the participants as one large group. Non-parametric correlations were calculated between the perceived singing competency and: a) overall voice quality in speech; b) overall voice quality in singing; c) ratings for individual voice parameters in speech; and d) ratings for individual voice parameters in singing.

As indicated in Chapter 6, specific voice parameters were perceived to be dominant forms of voice distortions amongst the participant children (see Section 6.5.2). Relationships between these particular parameters and singing competency were investigated in addition to the relationship between overall voice quality in speech and singing competency. Focussing on the overall voice quality in speech may have inhibited one from finding statistically significant relationships between specific voice parameters and the perceived level of speaking competency. Thus, the potential relationships between the individual voice parameters and the perceived level of singing competency were investigated.

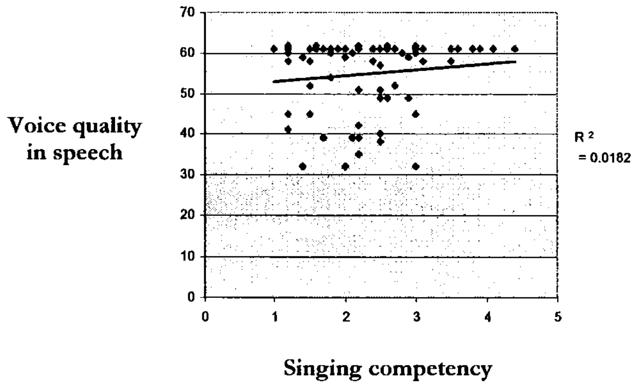
When working at the detailed sub-categories of voice quality, statistically significant relationships were found between perceived singing competency and voice gratings ($p<0.05$) and hypernasality ($p<0.05$) (see Table 19 in Appendix 1). For the remaining nine voice parameters (i.e. hoarse, rough, breathy, hyperfunctional, unstable pitch, voice-breaks, hard glottal attack, vocal fry, audible inhalation, hyponasality), the relationships were not statistically significant ($p>0.05$, n.s.).

The correlations between perceived singing competency and ratings for individual voice parameters in speech were not statistically significant ($p>0.05$) (see Table 20 in Appendix 1). The findings imply that perceived singing competency is not necessarily statistically significantly connected to the quality of individual voice parameters in speech, but it may have formed statistically significant relationships with specific parameters in singing. Such a finding was partially supported by the first small study that indicated that perceived singing competency may form statistically significant relationships with hyperfunctioning and voice-breaks in singing (see Appendix 2). However, this finding was not supported by the other small studies, including Study 2 involving similar children in the same school.

The correlation between perceived singing competency and overall voice quality in singing was not statistically significant ($r=0.192$, n.s.) (see Table 21 in Appendix 1) (see Figure 7.2). The correlation between perceived singing competency and overall voice quality in speech was not statistically significant either ($r=0.094$, n.s.) (see Table 22 in Appendix 1). Both of the correlations were positive and weak. Therefore, the findings imply that the level of children's perceived singing competency is not necessarily related to the overall quality of children's voice in either vocal behaviours.

The findings from the four small studies verified the findings from this Chapter (see Appendices 2-5). The correlations between perceived singing competency and overall voice quality in either vocal behaviour were not significant statically, indicating that the level of children's singing competency does not necessarily form significant relationships with the overall quality of children's voice. Therefore, the findings from the current study contradict the claims that advocate the idea of higher speaking or singing competency being associated with healthier and better voice quality.

Singing competency and voice quality in speech



Singing competency and voice quality in singing

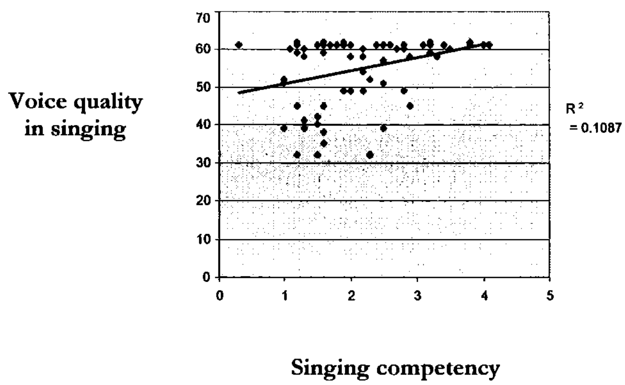


Figure 7.2: Scatterplots for perceived singing competency and overall voice quality in speech (left figure) and in singing (right figure) for the whole class

The potential relationship between overall voice quality and perceived singing competency was further investigated with two sub-groups. The first group consisted of those children with healthy overall voice quality (i.e. ratings 1-2) and the second group consisted of children with unhealthy overall voice quality (i.e. ratings 6-7) in order to explore whether ratings in the extremes of the scale generated statistically significant results. The correlations were statistically insignificant for both groups ($p > 0.05$, n.s.) (see Tables 23-26 in Appendix 1). The finding implies that perceived peaking competency was not related to overall voice quality in speech for any of the participants.

The findings, therefore, imply that the level of children's singing competency may have related to the quality of specific voice parameters in speech (i.e. hoarseness and unstable pitch). However, the level of singing competency did not form a significant relationship with overall voice quality in speech or singing, nor the ratings for individual voice parameters in singing.

7.4 Summary

The main finding was that the level of children's perceived speaking and singing competencies were not significantly related to the perceived quality of the participant children's voices and vocal functioning with regard to their speaking or singing behaviours. An additional finding was that perceived speaking competency may form statistically significant relationships with specific voice parameters in speech but not in singing. Similarly, perceived singing competency may form a statistically significant relationship with specific voice parameters in singing but not in speech. The four small studies supported these findings.

In summary, the findings imply that the perceived level of children's speaking and singing competencies do not necessarily form statistically significant relationships with the overall quality of children's vocal functioning and voice quality in speech or in singing, but such competencies may form statistically significant relationships with specific voice parameters.

Chapter 8: Findings from the psychological perspective

8.1 Introduction

The focus of this Chapter is data from the psychological perspective. Data for psychological factors and their connections to children's speaking and singing behaviours are presented (see footnote 1). Data for the 10-year-old participants are included in the analyses since such data were not available for the 7-year-old participants (see Appendix 5).

The intention of this Chapter was to explore whether the same psychological factors simultaneously influenced children's speaking and singing behaviours or whether such factors differed from one vocal behaviour to the other. These data were gathered with specially-designed questionnaire and interview schedules. The interview and questionnaire items were constructed on the basis of the proposed theoretical framework (see Chapter Three).

The data were analysed qualitatively with the assistance of Excel-software and quantitatively with the use of SPSS-software (version 14.0). The data were divided into six categories that had been formulated prior to data collection and on the basis of an extensive literature review (see Chapter Three). These categories were: a) learning and behavioural difficulties; b) vocal identity; c) self-esteem and self-worth d) personality characteristics; d) singing and other musical engagement; and e) psychological impact of singing.

8.2 Learning and behavioural difficulties

Data for different types of learning and behavioural difficulties were analysed. The intention was to investigate whether such difficulties formed significant relationships with the participant children's vocal functioning and voice quality in their speaking and

Footnote 1: The key features of this Chapter can be found in: Rinta, T. (2008). Potential use of singing in educational settings with children possessing speech and voice disorders: a psychological perspective. *British Journal of Music Education, July Issue* singing behaviours. The learning and behavioural difficulties considered in the analyses were: speaking difficulties, reading difficulties and behavioural difficulties. Non-parametric correlations were carried out in order to investigate the relationships between the above factors and the participant children's voice quality in their speaking and singing behaviours (see Footnote 2).

8.2.1 Speaking difficulties

Information on the participant children's speaking difficulties was obtained from the school records. Permission was granted by the Head Teachers and the children's parents prior to using the information for the current study. The diagnoses for speech disorders had been conducted by a professional speech therapist at the beginning of the school year. In the analyses, children with diagnosed speech difficulties were compared to those without diagnosed speech difficulties.

The non-parametric correlation between speech difficulty and overall voice quality in speech was not statistically significant ($r = -0.195$, n.s.) (see Table 27 in Appendix 1). The range of the ratings was wider for children with no speech difficulties (3.20) than for children with speech difficulties (2.50), suggesting that overall voice quality in speech varied more with children who did not possess speech difficulties than with those who possessed speech difficulties. The average voice quality was healthier for children with speech difficulties than for those without such difficulties. The boxplot illustrates the finding in graphic form (see Figure 8.1 below).

Footnote: 2a) Non-parametric analyses were used since the distribution of the voice quality ratings was positively-skewed and, therefore, a normal distribution could not be assumed (Robson, 2000).

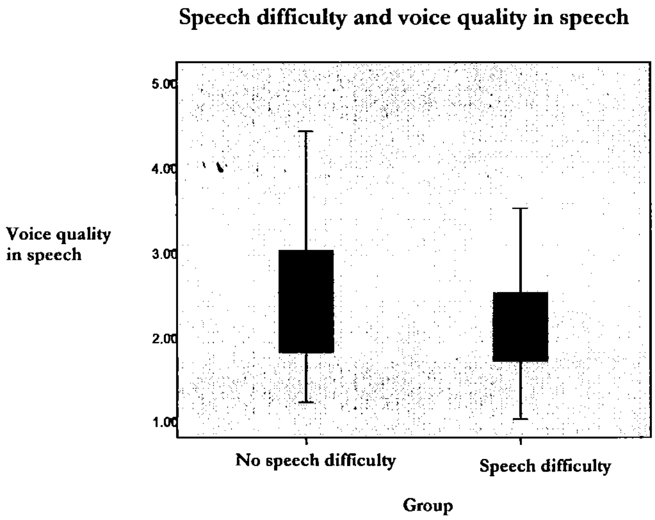


Figure 8.1: Boxplot for the relationship between speech difficulty and overall voice quality in speech

The non-correlation between speech difficulty and overall voice quality in singing was statistically significant ($r= - 0.399$, $p<0.05$) (see Table 28 in Appendix 1). The correlation was moderately strong and negative. The finding indicates that children with speech difficulties possessed healthier overall voice quality in singing than their peers without such difficulties. The range was also greater for children without speech difficulties (3.80) than for those with speech difficulties (2.30), indicating that there was a wider diversity of voice quality ratings recorded for the former than for the latter group. The boxplot illustrated the finding in graphic form (see Figure 8.2 below).

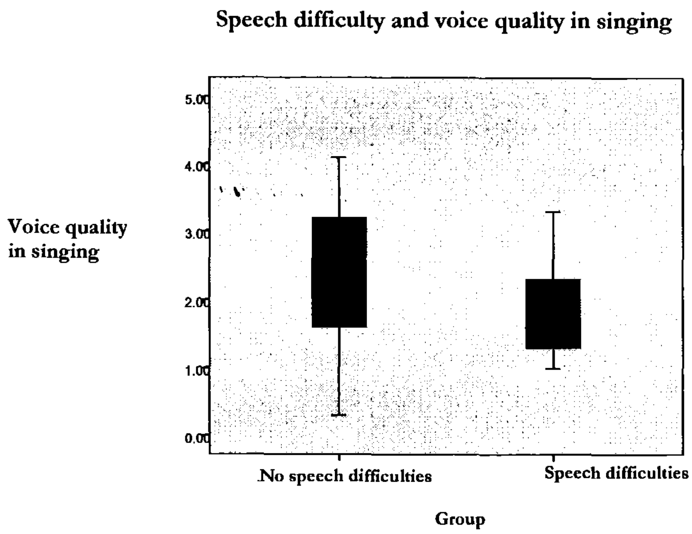


Figure 8.2: Boxplot for the relationship between speech difficulty and overall voice quality in singing

The four small supported and, at the same time, contradicted the above findings (see Appendices 2-5). Three out of the four studies suggested that speech difficulty formed a statistically significant relationship with overall voice quality in speech (see Appendices 2, 4-5). Therefore, there was strong indication for a significant connection between diagnosed speech difficulties and overall voice quality in speech. One of the four small studies supported the finding that speech difficulty formed a statistically significant relationship with overall voice quality in singing (see Appendix 3). This study provided further support for the above findings that children with speech difficulties possessed healthier overall voice quality in singing than children without such difficulties. The findings, therefore, suggest that speech difficulty may, at times, be connected to overall voice quality in either or both vocal behaviours. However, the findings need to be exposed to further research in order to draw firm conclusions (see Chapter 10 and 11).

Although there is indication for connections between diagnosed speech disorders and other forms of vocal distortions, it may be that a third factor (such as local environment) is simultaneously influences the children are speaking ability and their overall voice quality in their speaking and singing behaviours. Thus, it may be that speech disorders and voice quality in speaking and singing behaviours are not directly connected, but rather simultaneously influenced by additional factors (see Chapter 10).

8.2.2 Reading difficulties

Information on the participant children's reading difficulties was obtained from the school records. Such difficulties had been diagnosed by professionals working for the schools. Permission for using the information was granted by the Head Teacher. In the analyses, children with diagnosed reading difficulties were compared to those without diagnosed reading difficulties.

The non-parametric correlation between reading difficulties and overall voice quality in speech was statistically significant ($r = -0.348$, $p < 0.05$) (see Table 29 in Appendix 1). The correlation was relatively weak and negative. The range for voice quality ratings in speech was greater for children with reading difficulties (3.20) than for those without such difficulties (2.50). The boxplot below illustrates the finding (see Figure 8.3 below). The finding suggests that children possessing reading difficulties exhibited unhealthier overall voice quality in speech than their peers without such difficulties.

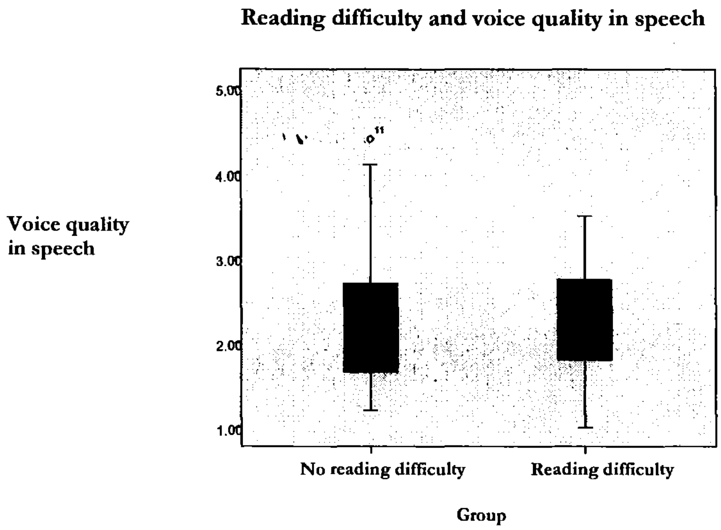


Figure 8.3: Boxplot for the relationship between reading difficulty and overall voice quality in speech

The non-parametric correlation between reading difficulty and overall voice quality in singing was not statistically significant (r= - 0.160, n.s.) (see Table 30 in Appendix 1). The range for overall voice quality ratings in speech was greater for children without reading difficulties than for those exhibiting reading difficulties (3.80 for former; 2.50 for latter). The boxplot illustrates the finding (see Figure 8.4).

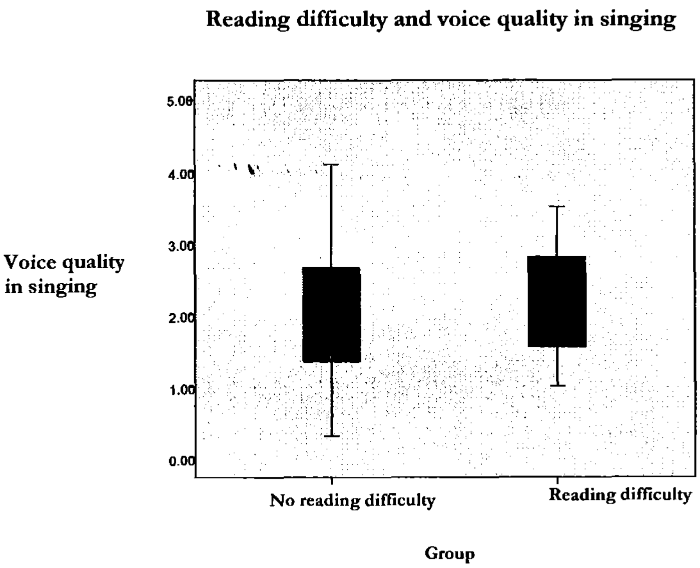


Figure 8.4: Boxplot for the relationship between reading difficulty and overall voice quality in singing

One of the four small studies supported the above findings that voice quality in speech (but not in singing) was connected to reading difficulties (see Appendix 2). The other three small-scale studies did not support the findings since the correlations were not significant (see Appendices 3-5). The findings, therefore, suggest that, at times, reading difficulty and overall voice quality in speech may form a significant relationship. It may be that an external factor (such as daily living environment) is needed for facilitating such connections. Such an external factors (or factors) may simultaneously influence children's reading ability and their voice quality. Such suggestions need to be exposed to further research in a subsequent study (see Chapter 11).

8.2.3 Behavioural difficulties

Information on the participant children's behavioural difficulties was obtained from the school records. Such difficulties had been diagnosed by professional psychologists working for the schools. Permission for using the data for the current study was obtained from the Head Teacher and the parents of the participant children prior to commencing the empirical phase of the study. In the analyses, children with diagnosed behavioural difficulties were compared to those without diagnosed behavioural difficulties.

The non-parametric correlation between behavioural difficulty and overall voice quality in speech was not statistically significant ($r = -0.005$, n.s.) (see Table 31 in Appendix 1). The range of the ratings were similar for both groups of children (behavioural difficulties: 1.80; without behavioural difficulties: 2.10). The boxplot below demonstrates the finding (see Figure 8.5).

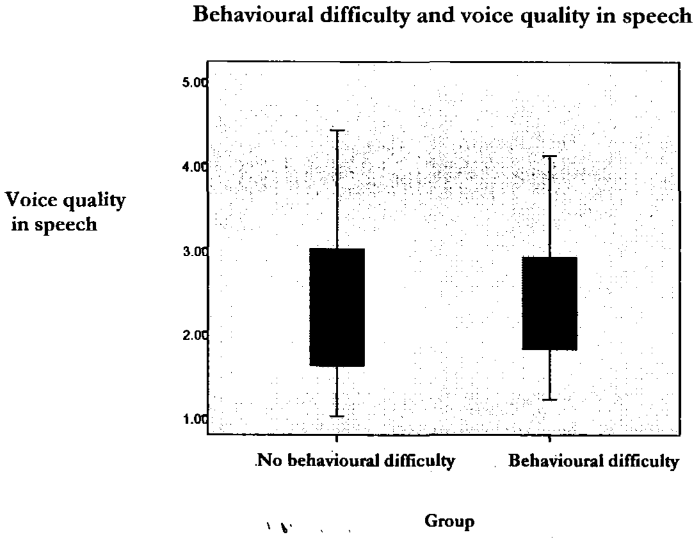


Figure 8.5: Boxplot for the relationship between behavioural difficulty and overall voice quality in speech

The non-parametric correlation between behavioural difficulty and overall voice quality in singing was not statistically significant (r=0.074, n.s.) (see Table 32 in Appendix 1). As with the overall speech voice quality ratings, the range of the ratings for overall voice quality in singing was similar for the two groups (behavioural difficulties: 1.30; no behavioural difficulties: 1.30). The boxplot below demonstrates the findings in graphic form (see Figure 8.6).

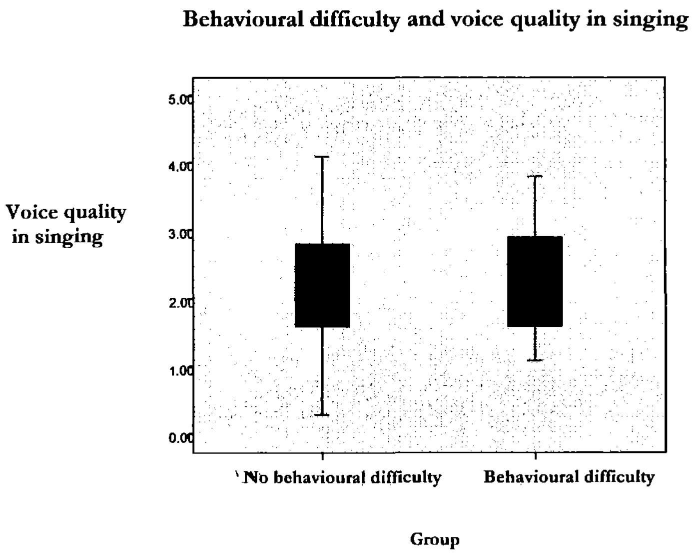


Figure 8.6: Boxplot for the relationship between behavioural difficulty and overall voice quality in singing

Despite the fact that the correlation was not statistically significant, the boxplot for overall voice quality in singing suggested that the children exhibiting behavioural difficulties also exhibited unhealthier overall voice quality in comparison to the children who did not exhibit behavioural difficulties, as evidenced by the mean ratings for the whole group. It may be, therefore, that there is a tendency for children with behavioural difficulties to exhibit less healthy voice quality in their singing behaviour.

Three of the four small-scale provided further support for such an indicative finding by indicating that behavioural difficulties and overall voice quality in speech formed a statistically significant relationship (see Appendices 2-4). One study suggested that behavioural difficulties and overall voice quality in singing also formed a statistically significant relationship (see Appendix 3). It may be, therefore, that behavioural difficulties at times form significant relationships with overall voice quality in either or both vocal behaviours. It may be that a third factor (such as school environment) is needed for facilitating the relationship and for developing a pre-disposition into such a significant relationship.

8.3 Vocal identity

The intention was to investigate any significant relationships between the participant children's overall voice quality and their vocal identity. In the analyses, children who possessed healthy overall voice quality were compared to those rated as possessing healthy overall voice quality in order to investigate whether there were differences recorded between these two groups with reference to their vocal identity.

Data from the 10-year-old participants were used in the analyses since the 7-year-old participants were not regarded old enough as to being able to respond to such queries reliably (see Appendix 5). Interviews and questionnaires were used in gathering the data (see Appendix 1 for questionnaire and interview schedules). The data were analysed qualitatively, with the assistance of EXCEL-software programme.

The first finding was that the majority of the children (67.7%) stated that they possessed 'a speaking voice' and 'a singing voice'. They argued that two distinct voices were separate entities, with 'a speaking voice' used for generating speech and 'a singing voice' used for generating singing (see Table 8.1).

Age-group	Regarded 'speaking and singing voices' as separate	Regarded 'speaking and singing voices' as integrated
10-year-olds (N=62)	67.7% (N=42)	32.3% (N=20)

Table 8.1: Percentages for children who perceived 'speaking and singing voices' as separate entities and for those who perceived them as an integrated entity

Distinctive responses were provided by the children according to their perceptions of their voices. For example, one boy who perceived his 'speaking' as being separated from his 'singing voice' claimed:

'You use your speaking voice for speaking and your singing voice for singing.'

Another girl from this group claimed:

'Hhmm...Yes, your voice is so different in speaking than in singing. You use different voices...Speaking voice and singing voice.'

A subset of the children (312.3%) claimed that 'speaking and singing voices' were an integrated entity and that the same voice was used for generating both vocal behaviours (see Table 8.1). For example, one girl from this group argued:

'I use the same voice in speaking and singing. It sounds nice when I speak and when I sing.'

Another boy from this group stated:

'It's the same voice. My voice sounds the same in speaking as it does it singing.'
The findings were supported by the three small-scale studies with the 10-year-old participants (see Appendices 2-4). In these studies, further evidence was found for the fact that the majority of the 10-year-olds perceived their 'speaking voices' and their

'singing voices' as two separate entities, rather than as an integrated entity. The findings, therefore, suggest that the participant children held traditional ideas as to possessing separate 'speaking and singing voices', with 'each voice' being used for generating a specific vocal behaviour.

The second finding was that a significant number of the children (16 out of 59/ 27.1 %) who regarded 'speaking and singing voices' as separate entities identified more positively with their 'singing voice' than with their 'speaking voice' (see Table 8.2). For example, one girl claimed:

'Oh, my singing voice is so beautiful. My speaking voice is ok.'

Another boy stated:

'My speaking voice is good. My singing voice is brilliant.'

Only five of the children who perceives 'speaking' and 'singing voices' as separate entities stated that they preferred the way their 'speaking voice' sounded to the way their 'singing voice' sounded. For instance, one boy argued:

'I don't like my singing voice. It sounds horrible. My speaking voice sounds alright though.'

Another girl claimed:

'My speaking voice sounds pretty good. My singing voice sounds...Hhmm...Awful.'

Age-group	**'Speaking voice' perceived in more positive way than 'singing voice'**	**'Singing voice' perceived in more positive way than 'speaking voice'**	**Not able to identify with voice**
10-year-olds (N=59)	10.2% (N=6)	27.1% (N=16)	62.7% (N=37)

Table 8.2: Percentages for perceptions of vocal identity when 'speaking and singing voices' were regarded two separate entities

The findings from the four small-scale studies provided further evidence for the above finding by suggesting that a greater number of children identified positively with their 'singing voices' rather than with their 'speaking voices' (see Appendices 2-5). The findings from the small studies also suggested that the majority of the participant children (N=53) were able to identify with their voices with reference to both their speaking and their singing behaviours.

The third finding was that a greater number of the children (N=12) who exhibited healthy and 'normal' voice quality in their speaking and singing behaviours possessed more positive vocal identities in comparison to the children (N=5) who exhibited unhealthy and 'abnormal' voice quality in their speaking and singing behaviours (see Table 8.3).

Voice quality (average rating for overall voice quality in speaking and singing)	**Negative vocal identity**	**Positive vocal identity**
'Normal' and healthy vocal functioning and voice quality (N=18)	11.8%	66.7%
'Abnormal' and unhealthy vocal functioning and voice quality (N=17)	88.2%	33.3%

Table 8.3: Relationship between voice quality and vocal identity

Distinct responses were received for negative and positive vocal identities. For example, a boy with healthy voice quality and positive vocal identity stated:

'My voice sounds wonderful when I speak. It also sounds wonderful when I sing. I like listening to my voice.'

Another girl from the same group claimed:

'I like the way my voice sounds when I speak and when I sing. It sounds beautiful and clear.

On the other hand, a boy with unhealthy voice quality argued:

'I don't really like the way my voice sounds. It is not so nice.'

Another boy with unhealthier voice quality claimed:

'My voice sounds ok… But I still don't like it that much.'

The findings from three small studies with 10-year-old participants supported the findings by suggesting that children with healthier voice quality held more positive vocal identities in comparison to children with unhealthier voice quality (see Appendices 2-4). The findings from the small studies suggested that there were stronger trends in the children's vocal identities amongst children with healthier voice quality than those with unhealthier voice quality. Children with healthy voice quality provided positive responses more consistently, whilst children with unhealthier voice quality generated a wider diversity of responses. The findings from the small studies also suggested that children in Finland were less likely to perceive 'speaking and singing voices' as two separate entities than the children in the UK.

The fourth finding was that the majority of the children (N=45) could identify the vocal mechanism that generated their speaking and singing behaviours. These children stated that the same physiological mechanisms generated the voice that they used as their main instrument for their speaking and singing behaviours. For instance, one boy claimed:

'My throat and mouth and tongue make speaking and singing happen.'

Another girl claimed:

'It's the muscles here…Close to mouth…They make the voice come out.'

The children who were not able to identify the underlying physiological mechanisms provided a variety of responses as to the elements that they perceived as generating their voices. For example, one girl claimed:

'My mouth makes my speaking happen...I don't know about singing...A microphone?'

Another girl claimed:

'The brain. The brain is essential in everything.'

The findings from three of the four studies supported the above findings (see Appendices 2-4). The findings, therefore, suggest that a significant number of the children perceived their 'speaking and singing voices' as two separate entities and as being used for generating two distinct vocal behaviours. Cultural differences were recorded: a stronger separation between 'speaking' and 'singing voices' was recorded in the UK than in Finland. The findings also suggested that there were differences with regard to vocal identity between children with healthier voice quality and those with unhealthier voice quality. The former group possessed a more positive vocal identity than the latter. Nevertheless, the participant children could identify with the underlying voice mechanisms relatively easily with reference to both vocal behaviours.

8.4 Self-esteem and self-worth

Data for self-esteem and self-worth were gathered through a personality inventory. The personality inventory used in the study was the Eysenck Junior Personality-test (see Appendix 1 for the full test). The results were analysed according to the guidelines set in the test manual. Each child was provided with a score for each specific personality characteristic. The scoring ranged from 0 to 6, and from descendent to ascendant, depending on the characteristics. Descriptive statistics were, therefore, relied on in the analyses. Due to the inconsistent nature of the scoring, interferential statistical analyses were not feasible. Comparisons were made between children who exhibited healthier overall voice quality and those who exhibited unhealthier overall voice quality.

The first finding was that children with healthier voice quality were more confident and self-assured than children with unhealthier voice quality when enquired about future events (see Table 8.4). The children in the former group were more likely to state that they believed that they would do well in a future event, whereas children in the latter group were more likely to state that they would not do well in a future event. The children in the former group were also more likely to state that they would do well in any activity than the children in the latter group. The findings imply that the children's voice quality may be connected to their self-confidence and self-esteem. It should be noted, however, that there may have been additional factors (such as personality characteristics) that facilitated the recorded differences between the children.

Items measuring self-worth / self-esteem	**Unhealthy voice quality** (ratings 5-7) (N=17)	**Healthy voice quality** (ratings 1-3) (N=18)
(S)he believes that (s)he would do well in a future event.	58.8% (N=9/ 17)	50% (N=9/ 18)
(S)he believes that (s)he would be able to engage in any type of activity.	24.2% (N=15/17)	83.3% (N=15/ 18)

Table 8.4: Percentages for self-efficacy statements for all the participants

The second finding was there were distinct differences between children exhibiting healthy voice quality and those exhibiting unhealthy voice quality as to self-reported feelings of confidence and happiness (see Table 8.5). The majority of the children with healthy voice quality (94.4%) stated that they felt confident and happy, whilst less than half (41.2%) of the children with unhealthier voice quality stated that they felt confident and happy. Only a low percentage (11.1%) of the children with healthy voice quality stated that they were angry, whereas a higher percentage (29.4%) of children with unhealthy voice quality reported to be experiencing feelings on anger. Feelings of happiness differed slightly between the two groups: 88.9 percent of the children with healthy voice quality stated to be happy, whilst 70.6 percent of the children with unhealthy voice quality claimed to be happy. There were less distinct differences recorded in the responses received for being quiet, with 38.9 percent of the children who possessed healthy voice quality claiming to be quiet and 35.5 percent of the children who possessed unhealthy voice quality.

Subjective perception	Healthy voice quality (N=18)	Unhealthy voice quality (N=17)
Confident	94.4% (N=17/ 18)	41.2% (N= 7/17)
Happy	88.9% (N=16/ 18)	70.6% (N=12/17)
Quiet	38.9 % (N= 7/18)	35.5% (N=6/17)
Angry	11.1% (N=2/18)	29.4 % (N=5/ 17)

Table 8.5: Percentages of biographical perceptions for different groups of children

The findings indicate that children with healthy voice quality exhibited higher levels of self-confidence and self-esteem in comparison to children with unhealthy voice quality. The findings were applicable to both speaking and singing behaviours. Children with healthy voice quality also demonstrated stronger feelings of self-efficacy than children with unhealthy voice quality. The findings were supported by the three small studies conducted with the 10-year-old participants (see Appendices 2-4).

8.5 Personality characteristics

Data on the children's personality characteristics were gathered with the Eysenck Junior Personality-test (see Appendix 1 for the full test). The results were analysed according to the guidelines set in the test manual. Each child was provided with a score for each specific personality characteristic (see Section 8.4 for a comprehensive description on the analyses for the test).

The first finding was that children who exhibited extraverted personality characteristics possessed unhealthier overall voice quality in their speaking and singing behaviours than children who exhibited introverted personality characteristics (see Table 8.7 below). The connection is evident in the fact that 65 percent of the children with unhealthier overall voice quality were classified as extraverted, whilst only 27 percent of children with healthier overall voice quality were classified as extraverted.

The second finding was that children who exhibited extraversion and unhealthier voice quality were more likely to engage in active rather than passive hobbies in their leisure time in comparison to their peers who exhibited introversion and healthier voice quality (see Table 8.6). 65 percent of the children in the formed group engaged in active leisure hobbies, whilst and 27 percent in the latter group engaged in such activities. 35 percent of the extraverted participants engaged in passive hobbies, whereas 73 percent of the introverted children engaged in such hobbies in their free time.

Personality characteristic and voice quality	**Active leisure hobbies (such as sports)**	**Passive leisure hobbies (such as watching TV)**
Extraverted and less healthy overall voice quality in speech and singing (N=26)	65%	35%
Introverted and healthy overall voice quality in speech and singing (N=28)	27%	73%

Table 8.6: Relationship between personality characteristics, voice quality and leisure activities

The findings indicate that there was a relationship between children's voice quality, personality characteristics and their leisure hobbies. Extraverted personality characteristics and voice quality formed significant relationships with one another, whilst introverted personality characteristics formed a considerable relationship with healthy voice quality.

The findings were supported by two out of the four small studies (see Appendices 2-3). The third small study (see Appendix 4) contradicted the findings by indicating that a number of children with introverted personality characteristics also exhibited unhealthy voice quality. The first two studies were conducted in the UK, whilst the third one was conducted in Finland. It may be, therefore, that cultural aspects played a role in shaping the relationship between personality characteristics and voice quality. It seems that an additional factor is needed for facilitating the connections between the children's vocal functioning, their personality characteristics and choice of leisure activities (see Chapter 10 for a more in-depth discussion).

8.6 Singing and musical engagement

Data for the participant children's singing and musical engagement were gathered with questionnaires. The same questionnaire was used as for investigating the psychological impact of singing (see Appendix 1 for the questionnaire schedule). The results were analysed qualitatively with the assistance of EXCEL-software programme. Comparisons were made between children exhibiting healthier voice quality and those exhibiting unhealthier voice quality. Data from the 7-year-old participants were not available for the analyses and, therefore, data for the 10-year-old children were used (see Appendix 5).

The first finding was that a greater number of children with healthier voice quality (64.7%) were engaged in singing and other musical activities in comparison to children with unhealthier voice quality (22.2%) (see Table 8.7 below). At the same time, a greater number of children with unhealthy voice quality (77.8%) stated that they were not engaged in singing or musical activities in comparison to their peers with unhealthier voice quality (43.9%). The second finding was that a significant number of the children were engaged in singing and other musical activities than those who were not, regardless of their of their vocal health (see Table 8.7).

Voice quality	**Engaged in singing and other musical activities**	**Not engaged in singing and other musical activities**
Healthy overall voice quality (N=17)	66.7%	43.9%
Unhealthy overall voice quality (N=18)	29.6%	11.8%
Less healthy overall voice quality (N=27)	51.9% (N=14/ 27)	48.1% (N=13/ 27)

Table 8.7: Relationship between voice quality, singing engagement and other musical hobbies

The findings imply that vocal health and singing engagement, as well as other musical activities, are connected. Healthy voice quality was associated with singing and other musical engagement. Children with healthier voice quality were also more likely to state whether they did (or did not) engage in singing or other musical activities than children with unhealthier voice quality were.

Two out of the three small studies supported such findings and provided strong evidence for the recorded distinctions between children who exhibited healthy voice quality and those who did not exhibit unhealthy voice quality in terms of their musical and singing engagement (see Appendices 2-3). One of the groups was based in the UK and the other one in Finland. Thus, the findings were not necessarily reliant on the eider culture the children were from. Rather, it may be that differences in local culture and daily environment facilitated the recorded differences. Furthermore, the findings from one of the small studies indicated that there was no such considerable difference between children with healthy voice quality and those with unhealthy voice quality (see Appendix 4). Therefore, it may be that additional internal and/ or external factors are needed for facilitating the network of psychological factors and children's voice quality.

8.7 Psychological impact of singing

The psychological impact of singing was investigated with questionnaires. The same questionnaire was used for the inquiry as the one investigating the participant children's singing and musical engagement (see Section 8.6 above) (see Appendix 1 for the questionnaire schedule). The results were analysed qualitatively with the assistance of EXCEL-software programme. Comparisons were made between children exhibiting healthy voice quality and those exhibiting unhealthy voice quality. Comparisons were also drawn between children who were engaged in singing on a regular basis and those who were not engaged in singing on a regular basis. Data for the 10-year-old participants were used.

The first finding was that singing served a number of psychological functions for the participant children. Examples of such functions were: singing was perceived to be a calming activity; singing was perceived to be relaxing; singing was perceived to be energising; singing provided the children with something fun to do; and singing was perceived as an activity that made the children feel happy. For instance, one boy claimed:

'I like singing since it makes me feel happy. It gives me something fun to do. Afterwards I feel much better.'

A girl claimed:

'Singing makes you feel relaxed and calm. I feel so still after singing…'

The second finding was that a greater number of children with healthy voice quality (N=15) stated that they associated singing activities with positive rather than negative functions (N=2). For instance, one girl claimed:

'I love singing. It is so nice. It is one of them nicest activities to do on your own or with others.'

Another boy from this group stated:

'Singing is a good activity. I feel so good about doing it. I feel like singing all the time.'

The third finding was that the majority of the children with unhealthy voice quality (N=14) associated positive rather than functions with singing (N=3), despite the fact that they were less likely to engage in such activities. For example, one girl claimed:

'I think singing is fun. But I don't really sing…I find it a scary activity.'

Another girl from this group stated:

'I like it. It is good to do. I don't do it much though. I am not used to it.'

The fourth finding was that all of the children (N=21) who were engaged in singing on a regular basis indicated that they found such activities enjoyable. For instance, a boy stated:

'It is a lot of fun and I find it very enjoyable.'

Another boy from this group claimed:

'It is motivational and uplifting and enjoyable...I like it a lot.'

The fifth finding was that children (N=18) who were not regularly engaged in singing activities held negative associations with such activities. For instance, one boy claimed:

'I find it scary...I get scared when I have to do it. It is daunting.'

Another girl from this group stated:

'I like singing, but I get so scared. I feel insecure and bad when I have to do it.'

The findings imply that voice quality and the perceived psychological functions associated with singing engagement were connected. The findings suggest that vocal health and familiarity with singing activities were connected to children's perceptions of such activities. The three small studies with 10-year-old participants supported the above findings (see Appendices 2-4).

8.8 Summary

The findings for the psychological perspective can be summarised as follows:

a) Speech difficulties and voice quality in singing, but not in speech, were connected. The findings from the small studies implied that the connections between speech difficulties and voice quality may vary from one vocal behaviour to another, depending on the participant population.

b) Reading difficulties and voice quality in speech but not in singing were connected. The findings from the small studies indicated that the connections between reading difficulties and voice quality may vary from one vocal behaviour to another, depending on the participant population.

c) Behavioural difficulties and voice quality in either vocal behaviour were not connected.

d) Voice quality in both speaking and singing behaviours was connected to the level of children's self-esteem and feelings of self-efficacy.

e) Personality characteristics and vocal health were connected. Extraverted personality characteristics were associated with unhealthier voice quality, whilst introverted personality characteristics were associated with healthier voice quality.

f) Singing engagement, musical hobbies and vocal health were connected. Greater amount of singing engagement and musical hobbies were connected to vocal health.

g) Perceived psychological benefits of singing, singing engagement and vocal health were connected. Healthier voice quality and greater amount of singing engagement were associated with more positive perceptions on the psychological benefits arising from singing engagement.

Chapter 9: Findings from the sociological perspective

9.1 Introduction

The focus of this Chapter is data for sociological factors and their connections to children's speaking and singing behaviours are presented. The intention was to explore whether the same sociological factors were simultaneously connected to children's speaking and singing behaviours or whether such factors differed from one vocal behaviour to the other.

The data for sociological background factors were gathered via questionnaires, interviews and observation. The items for the instruments had been constructed on the basis of an extensive literature review (see Chapter Three). The data were analysed with the assistance of EXCEL-software programme. The findings were divided into six categories, formulated on the basis of the literature review. These categories were: a) linguistic background; b) siblings; c) sex; d) socioeconomic background; e) age; and f) leisure activities.

9.2 Linguistic background

Differences were recorded between children according to their cultural backgrounds with reference to their vocal functioning and voice quality in their speaking and singing behaviours. The majority of native English- and Finnish-speakers (95%) exhibited healthy and 'normal' voice quality in both vocal behaviours. A considerable number of children from Asian background (66.7%) also exhibited healthy and 'normal' voice quality in both vocal behaviours, whilst a considerably smaller number of children of African (33.3%) and Middle-Eastern (42.9%) origins exhibited healthy and 'normal' voice quality in their speaking and singing behaviours (see Table 9.1 below).

Cultural background	Healthy and 'normal' voice quality (ratings 1-3)	Unhealthy and 'abnormal' voice quality (ratings 5-7)
English (N=20)	95% (N-19/ 20)	5% (N=1/ 20)
Finnish (N=34)	94.1% (N=32/ 34)	5.9% (N= 2/ 20)
Asian (N=6)	66.7% (N=4)	33.3% (N= 2/ 6)
Middle-eastern (N=7)	42.9% (N= 3/ 7)	57.1% (N= 4/ 7)
African (N=9)	33.3% (N= 3/ 9)	66.7% (N= 6/ 9)

Table 9.1: Percentages for perceptually healthy and unhealthy vocal functioning and voice quality for children of different cultural backgrounds

The findings, therefore, suggest that voice quality varies according to children's cultural background. A greater number of unhealthy and 'abnormal' vocal characteristics were recorded with individual of specific cultural backgrounds (such as with children of Middle-Eastern origin). The findings were supported by the four small-scale studies (see Appendices 2-5). It may be that the participant children's first languages had shaped their voice quality. In addition, cultural factors from the children's local surroundings may have influenced the children's voice quality. Alternatively, other external (such as cultural norms) or internal factors (such as the children's perceptions of their own voices) may have significantly influenced the children's final vocal products.

As illustrated in Chapter 6, differences were recorded in the dominant vocal characteristics exhibited by the participant children (see Table 9.2). For a significant number of the English children (64%), it was 'normal' to exhibit a degree of hoarseness and roughness, whilst a significant number of the Finnish children (65%), it was 'normal' to exhibited a degree of hypernasality. For the majority of the children from African (91%) and Middle-Eastern backgrounds (92%), it was 'normal' to exhibit relatively harsh and rough voice quality, whilst the dominant voice characteristics of children from Asian (34%) backgrounds were voice gratings and hypernasality. The four small-scale studies supported the above findings (see Appendices 2-5).

Cultural background	Perceived 'normal' and dominant vocal characteristics	Prevalence of the dominant vocal characteristics
English (N=20)	A degree of perceived roughness and hoarseness; relatively clear overall voice quality	64%
Finnish (N=34)	A degree of perceived nasality; relatively clear overall voice quality	65%
African (N=9)	A harsh and rough overall voice quality	91%
Middle-eastern (N=7)	Relatively harsh and rough overall voice quality	92%
Asian (N=6)	A degree of nasality and vocal gratings; relatively clear overall voice quality	34%

Table 9.2: Dominant vocal characteristics that can be perceived as 'normal' and acceptable in the indicated cultures

The findings, therefore, imply that general trends were recorded in children's dominant vocal characteristics that can be classified as 'normal' according to the cultural backgrounds of the children. It should be noted that cultural aspects need to be taken into consideration in perceptual voice assessment. The cultural background of the raters in the current study may have influenced the outcome of their assessment task due to the fact that the judges may have been accustomed to listening to particular vocal sounds and characteristics and regarded these as 'normal'. The judges for the study were from English, Finnish and Croatian backgrounds, therefore being more sensitive to identifying specific vocal distortions that are more evident in their culture. Judges of other cultural origins may have performed the task according to their own norms of vocal health. For example, a judge from an Arabic background may have perceived harsh and rough voice quality as 'normal', whilst a judge from a Finnish background may have perceived such voice quality as 'abnormal'. Therefore, the findings presented here for linguistic background should be considered with caution and be treated as indicative of potential cultural trends.

9.3 Siblings

The relationships between the sibling order in one's families, the number of siblings in the families and one's voice quality in speaking and singing were investigated. When looking at sibling number, the data were divided into four categories: a) no siblings; b) one sibling, c) two siblings; and d) three or more siblings. When looking at sibling order, the data were divided into four categories: a) only child; b) youngest child in the family; c) middle child in the family; and d) oldest child in the family. Non-parametric correlations were calculated in order to investigate the relationships between the variables.

The non-parametric correlation between the number of siblings and children's overall voice quality in speech was statistically significant ($r=0.328$, $p<0.05$) (see Table 33 in Appendix 1). The finding is illustrated by the boxplot below (see Figure 9.1). The ranges for voice quality in speech for the different categories varied: for children without any siblings, the range was 1.50; for children with one sibling, the range was 0.90; for children with two siblings, the range was 1.40; and for children with three or more siblings, the range was 0.50. The boxplot demonstrates that the greater the sibling number in a child's family, the unhealthier the child's voice quality in speech was likely to be. The plot also indicates that children without siblings exhibited unhealthier voice quality in speech than children with siblings.

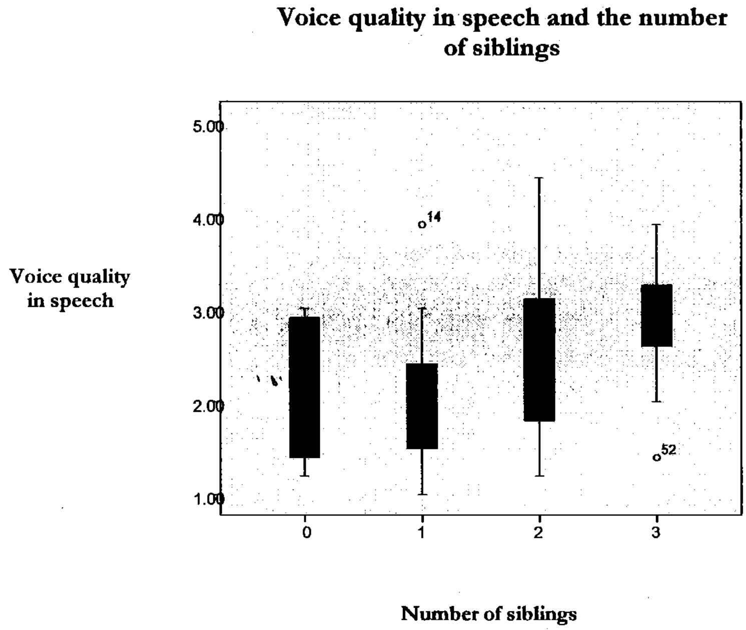


Figure 9.1: Relationship between child's voice quality in speech and their sibling number

The findings were supported by two out of the four small-scale studies (see Appendices 2 and 3). The findings, therefore, indicate that the number of siblings may be related to children's voice quality in speech. It may also be that additional factors (such as a child's psychological state) may have significantly influenced the child's voice quality in speech.

The non-parametric correlation between the number of siblings and children's voice quality in singing was not statistically significant (r=0.156, n.s.) (see Table 34 in Appendix 1). The ranges for voice quality in speech varied from one group to the other: for children without any sibling, the range was 0.70; for children with one sibling, the range was 1.00; for children with two siblings, the range was 1.20; and for three or more siblings, the range was 2.00. The boxplot below demonstrates the finding (see Figure 9.2 below). Although the correlation did not reach statistical significance, the boxplot indicates that a greater sibling number or no siblings were connected to unhealthier voice quality. The findings imply that the number of children's siblings is not necessarily significantly related to children's voice quality in singing.

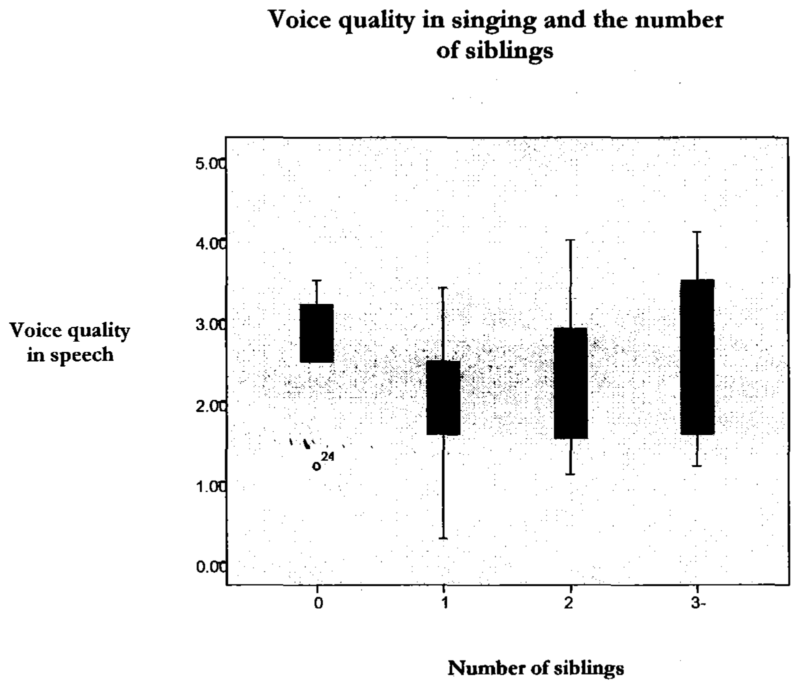


Figure 9.2: Relationship between children's voice quality in singing and their sibling number

The findings were supported by the two out of the four small-scale studies (see Appendices 2 and 3). The remaining two studies indicated that sibling order and sibling number did not form statistically significant relationships with vocal health. Since the first two studies were conducted in the UK and the latter two in Finland, it may be that additional factors (such as local environment or children's psychological well-being) are needed for facilitating the relationships between children's vocal health and sibling factors.

The non-parametric correlation between sibling order and children's voice quality in speech was not statistically significant (r=0.66, n.s.) (see Table 35 in Appendix 1). The correlation between sibling order and children's voice quality in singing was not statistically significant either (r=0.054, n.s.) (see Table 36 in Appendix 1). Nevertheless, two out of the four small-scale studies indicated that eldest siblings exhibited the unhealthiest voice quality in both vocal behaviours (see Appendices 2-3). Since both of these studies were conducted in the UK, it may be that sibling-order in combination with other factors (such as local culture) may have shaped the participant children's vocal health, at times posing a deteriorating effect on their voice quality.

9.4 Sex

The relationships between the children's sex and their voice quality in their speaking and singing behaviours were investigated. Non-parametric correlations were conducted. The correlation between sex and voice quality in speech was not statistically significant (r= -0.009, n.s.) (see Table 37 in Appendix 1). The range for the voice quality ratings in speech was similar for boys and girls (1.20 for the former versus 0.80 for the latter group). The boxplot below illustrates the finding (see Figure 9.3 below).

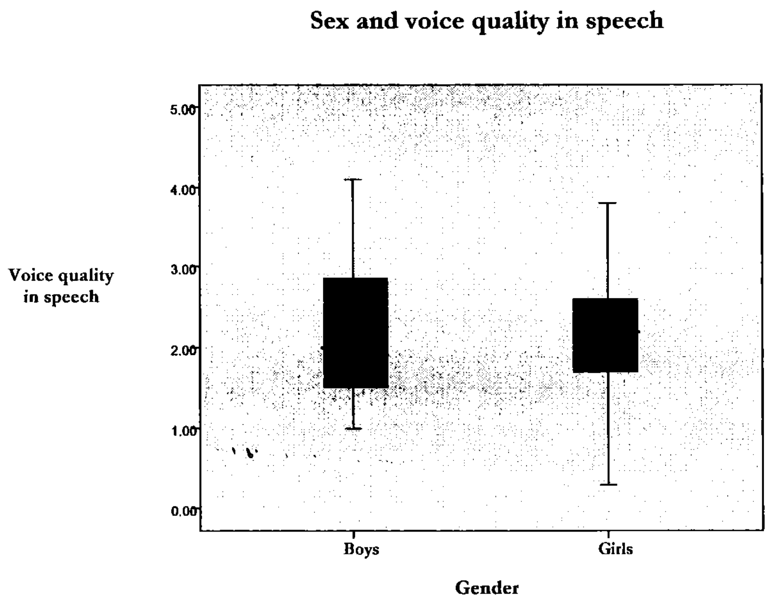


Figure 9.3: Boxplots for the relationship between sex and voice quality in speech

The non-parametric correlation between sex and voice quality in singing was not statistically significant either (r = 0.018, n.s.) (see Table 38 in Appendix 1). The range for the voice quality ratings in singing was greater for boys than for girls (1.30 for the former versus 0.70 for the latter). The boxplot below demonstrates the findings (see Figure 9.4).

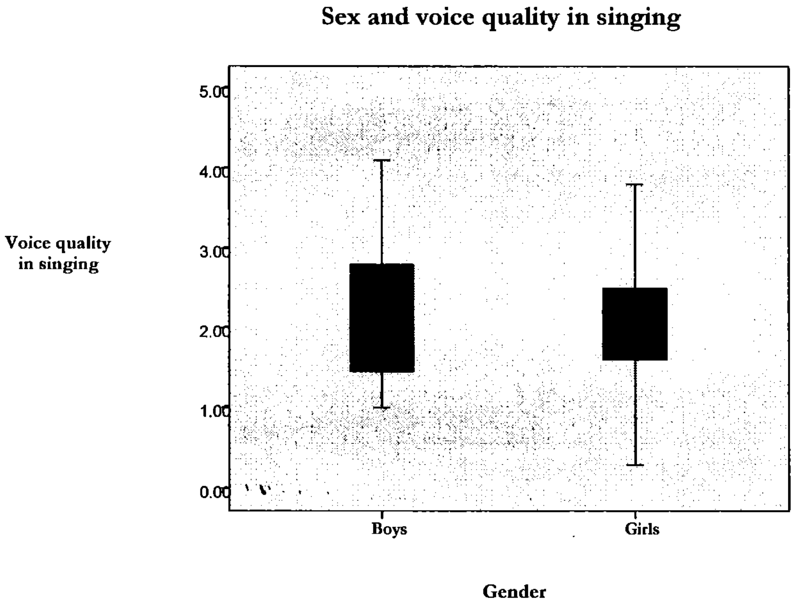


Figure 9.4: Boxplots for the relationship between sex and voice quality in speech

The findings were supported by three out of the four small-scale studies (see Appendices 3-5). However, the first small study indicated that girls exhibited unhealthier voice quality than boys did (see Appendix 2). The findings, therefore, suggest that there are no general trends with regard to the relationship between children's sex and their voice quality neither in wither vocal behaviour. It may be that additional factors are needed for facilitating a significant correlation.

9.5 Socio-economic status

The classification of socioeconomic status was constructed on the basis of information derived from the school records regarding free school dinners. In the UK, there were only three children classified as belonging to lower socioeconomic status. In Finland, information on socioeconomic statuses was considered as of too confidential in nature. Therefore, the Head Teacher refused to provide the researcher with such information.

Since there were only three children belonging to the group representing lower socioeconomic status, it was not feasible to carry out statistical analysis. Thus, the potential relationship between socioeconomic status and voice quality could not be investigated with the participant children. A separate study needs to conducted with specific emphasis on sociological factors in order to be able to conduct the proposed analyses.

9.6 Age

The relationship between the children's age and their voice quality in speaking and singing behaviours was investigated. Since the participant population consisted of 7-10-year-olds, comparisons were made between 7-year-olds and 10-year-olds in order to take maximum benefit of the age-difference in this population.

The non-parametric correlation between age and voice quality in speech was not statistically significant (r=0.176, n.s.) (see Table 39 in Appendix 1). The range for the ratings was greater for the group of 10-year-olds than for the group of 7-year-olds (3.40 for the former versus 1.50 for the latter). The boxplot below ollustrates the finding (see Figure 9.5).

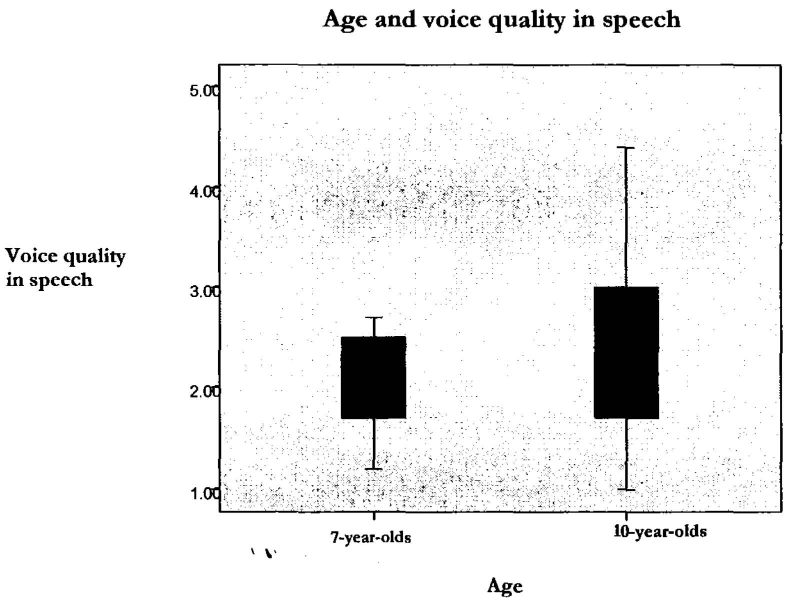


Figure 9.5: Boxplot for the relationship between age and voice quality in speech

The non-parametric correlation between age and overall voice quality in singing was statistically significant (r=0.379, $p<0.05$) (see Table 40 in Appendix 1). The range of the ratings was greater for the group of 10-year-olds than for the group of 7-year-olds (3.80 for the former versus 1.50 for the latter). The boxplot below illustrates the finding (see Figure 9.6).

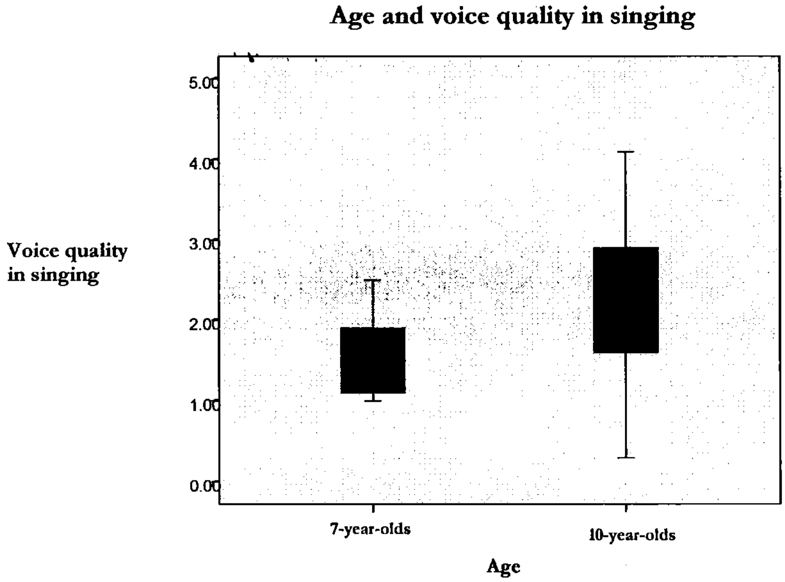


Figure 9.6: Boxplot for the relationship between age and voice quality in singing

The findings imply that age was related to children's vocal functioning and voice quality in singing, with the quality being healthier in older children than in the younger ones. It may be that an additional factor (such as local culture) has shaped the children's vocal functioning and voice quality. Rather than age possessing an effect on its own, it may be that older children have been exposed to cultural norms and feedback from their surroundings for a longer period of time in comparison to their younger peers, reflected in the recorded differences.

The findings from the four small-scale studies indicated that there were no significant differences recorded between the children belonging to different age-groups (see Appendices 2-5). It should be noted, however, that the age-differences within each small study were minimal due to the fact that the children in each group were born within one year. The age-differences may have been too narrow for statistically significant differences to be recorded. Wider age-differences within the whole participant population (i.e. 3 years of age-difference) consequently highlighted the age-difference.

The above finding suggesting that older children exhibited unhealthier voice quality than their younger peers was verified when looking at the prevalence of 'abnormal' vocal characteristics exhibited by the two groups (see Table 9.3). 15.3 percent of the 10-year-olds possessed unhealthy or 'abnormal' vocal characteristics. None of the 7-year-olds exhibited such 'abnormal' characteristics. The finding, therefore, imply that older children were more likely to exhibit unhealthy and 'abnormal' vocal functioning and voice quality with reference to their speaking and singing behaviours. It may also be that there were additional factors (such as their local culture) that caused the older children's vocal functioning and voice quality to be unhealthy, rather than their age as such.

Age group	**Prevalence of 'abnormal' vocal characteristics**
10-year-olds (N=59)	15.3%
7-year-olds (N=17)	0%

Table 9.3: Prevalence of 'abnormal' vocal characteristics in 7- and 10-year-olds

9.7 Leisure activities

The potential relationship between leisure activities and children's vocal health was explored. Non-parametric correlations were conducted in order to investigate such a relationship. Data for the 10-year-old participants were used since the 7-year-olds were not old enough to provide reliable responses to the questions, as stated by their classroom teacher (see Appendix 5).

Comparisons were made between children with healthier voice quality and those with unhealthier voice quality. Children with unhealthier voice quality (N=22) stated that they enjoyed being engaged in active hobbies (such as playing in the playground with their friends or going to the park) in their leisure time. These children were mostly engaged in outdoor activities. Children with healthier voice quality (N=22), on the other hand, preferred more solitary leisure activities (such as watching TV or playing computer games at home) (see Table 9.4). These children were mostly engaged in passive activities in their leisure time. The remainder of the children were engaged in both active and passive activities.

Vocal health	Active hobbies (N=22)	Passive hobbies (N=22)
Healthy voice quality (1-3)	35%	65%
Unhealthy voice quality (5-7)	84%	16%

Table 9.4: Connections between leisure activities and vocal health

It may be that the children's leisure activities had shaped their vocal functioning and voice quality in their speaking and singing behaviours. Alternatively, it may be that the children's vocal functioning and voice quality had influenced their decision as to which type of leisure activities to engage in. For instance, the children who exhibited unhealthier voice quality may have abused their voices in their leisure time due to the fact that such activities had required a greater amount of vocal volume in comparison to passive and solitary activities. Alternatively, it may also be that an additional factor (such as cultural norms on the appropriateness of particular activities) influenced the children's choice of leisure activities, subsequently being reflected in their voice quality.

9.8 Summary

The findings for the sociological factors can be summarised as follows:

a) The participant children's linguistic background formed a significant relationship with the children's voice quality in their speaking and signing behaviours. General trends in vocal functioning and voice quality for both vocal behaviours were recorded between different cultural groups that the participant children belonged to.

b) The number of siblings formed a significant relationship with the children's vocal healthy in their speaking and singing behaviours. The greater the sibling number, the unhealthier the child's voice quality in speech (but not in singing) was likely to be. Children without any siblings exhibited unhealthier voice quality in their speaking and singing behaviours than children with siblings did.

c) The sex of the children did not form a statistically significant relationship with their vocal functioning and voice quality in either vocal behaviour.

d) The age of the children formed a statistically significant relationship with the children's vocal functioning and voice quality in regard to their singing behaviours but not with reference to their speaking behaviour. The older the children were, the unhealthier their vocal functioning and voice quality were likely to be.

e) Leisure activities formed a statistically significant relationship between the children's vocal functioning and voice quality with regard to their speaking and singing behaviours. Active hobbies were associated with unhealthier voice quality, whilst passive hobbies were associated with healthier voice quality.

Chapter 10: Discussion

10.1 Introduction

In Chapters 3 and 6-9, it has been demonstrated theoretically and empirically how pre-pubertal children's speaking and singing behaviours are connected from different perspectives. In these Chapters, physiological, psychological and sociological perspectives were considered. Potential connections from the neurological perspective were also discussed from the theoretical perspective, and perceived competency in speaking and singing behaviours were considered.

In this Chapter, the findings from the empirical investigation (Chapters 6-9) are critically discussed in relation to the reviewed literature (Chapters 2-4), and the significance of the current investigation is highlighted. Firstly, culturally-located 'normality' and 'abnormality' of the child voice are considered. Secondly, inter-connections between children's 'speaking' and 'singing voices are discussed. Thirdly, a variety of holistic factors that are connected to children's speaking and singing behaviours are reviewed. Fourthly, the relationships between the levels of speaking and singing competencies and children's vocal products are considered. Finally, the potential inclusion of singing and holistic factors in the perceptual assessment of the child voice are discussed.

10.2 Culturally-located 'normality' of children's vocal functioning and voice quality

'The normality' and 'the abnormality' of pre-pubertal children's vocal products in their speaking and singing behaviours remain an under-researched area (Hunt and Slater, 2003; Mathieson and Greene, 2003; Sergent and Welch, 2007; Wilson, 1987). There are no formal definitions for perceptually 'normal' or 'abnormal' characteristics of the child voice, nor its acoustic correlates, with regard to both speaking and singing behaviours (Blumin, 2007; Carding et al., 2000; Moerman et al., 2007; Van der Wel, 2007; Welch, 2005). Furthermore, it is not known whether such concepts of 'normality' and 'abnormality' vary from culture to culture (Bolfan-Stosic et al., 2003; Welch, op.cit.), although a number of studies have indicated such variation, as evidenced in studies on

196

how a child's first language shapes the child's vocal products (Bunning, 2004; Brown et al., 2004; Costa-Giomi, 2002; Cross, 2002; Papousek, 1996; Sandbank, 1989; Sloboda, 2000; Welch, op.cit.). This evident lack of knowledge poses challenge to professionals in education and therapeutic fields as to diagnosing children with speech and voice distortions (Andrews, 1991; Mathieson and Greene, 2003). Consequently, professional speech and voice therapy practice has been regarded to be subjective and dependent on individual practitioners (Carding et al., 2000; Yamaguchi et al., 2003).

Furthermore, previous studies on 'normal' and 'abnormal' characteristics of the child voice have primarily focussed on children's speaking behaviour (Andrews, 1991; McAllister, 1997; Sederholm, 1996; White, 2001; Wilson, 1987). Therefore, it is not known whether the findings from such studies extend to singing behaviour (Andrews, op.cit.; Mathieson and Greene, 2003; McAllister, op.cit.; Sederholm, op.cit.; Wilson, op.cit.). The most comprehensive formal research studies in the field were conducted in Sweden (McAllister, 1997; Sederholm, 1996). The study indicated that it was 'normal' for 10-year-old Swedish children to possess a perceived degree of hoarseness in their speaking behaviour (McAllister, op.cit.; Sederholm, op.cit.), with smaller-scale studies in the UK having tentatively supporting such findings (Sergent and Welch, 2007; Williams et al., 2005; White, 2001). These UK studies have been concerned with both speaking and singing behaviours, therefore, supplementing the findings from the previous studies with additional data on children singing behaviour. It should be noted that all of these studies have relied on different voice assessment methods (i.e. either acoustic analyses or different forms of perceptual voice assessment), subsequently complicating the process of comparing the findings from the studies against one another.

The current study indicated that the 'normal' and 'abnormal' characteristics of the child voice are culturally-located. The findings suggest that distinct perceptual voice data gathered from children of different cultural origins in terms of the vocal elements that were perceived as 'normal' and those as 'abnormal', as evidenced in perceptual assessment (see Chapter 9). Considerable differences in voice quality were recorded between children of Asian, African and European origins. For example, children of Arabic origin generally exhibited unhealthier voice quality, whilst children of Finnish origin were more likely to exhibit a perceived degree of nasality. Furthermore, different types of biases were recorded in the voice quality rating distributions for each cultural

197

group, with the biases in each distribution highlighting the dominant vocal features for each cultural group in speaking and singing behaviours. For instance, hoarse voice quality was a common characteristic for children of Somali origin, whereas rough voice quality was common amongst children of Arabic origin. Such clear differences were recorded in the children's speaking and singing behaviours.

It may be that a variety of factors in the children's cultural surroundings, as well as the children's mother-tongues had shaped the children's vocal products, as suggested in previous studies (Papousek, 1996; Welch, 2005). In fact, interaction between local and global cultural factors appeared to be connected to the children's speaking and singing behaviours. For instance, a child's sex in combination with the child's first language facilitated by feedback the child had received for their vocal behaviours are likely to have significantly shaped the child's final vocal products. On the basis of such findings, it may be that stronger cultural trends in vocal characteristics are found in specific cultures than in others (see Section 10.4.4). For example, relatively strong trends were recorded in Somali children who tended to exhibit hoarse voice quality, whilst there were not as strong trends recorded amongst English children. However, since the current study did not specifically focus on investigating the cultural aspect, only indication for cultural differences can be provided.

The current study supported such claims that different types of languages shape children's vocal output in unique ways as a result of the sounds that they primarily consist of (Papousek, 1996; Welch, 2005) (see Chapter 9). For example, Arabic children may have possessed rough and harsh voice quality due to the sounds that Arabic-language primarily consists of. It is likely that factors from the children's cultural environment in combination with linguistic factor have shaped the children's vocal products to exhibit particular characteristics. In addition, different dominant characteristics were found in children located in the same culture, indicating that the children's local environment may have been of a prime influential factor for shaping their vocal output. For instance, there were wide differences recorded amongst the British participants, with a variety of their background factors possibly contributing to their vocal health. It may be that, in particular cultures, children's immediate environment encourages vocally-abusive behaviours (such as shouting with peers), subsequently posing a deteriorating effect on the children's voices.

198

Furthermore, it may be that different cultures hold their own concepts of accepted 'normal' and 'abnormal' vocal characteristics. For example, hoarse voice quality may be accepted and considered 'normal' in some cultures, such as those in Africa. Since the judges carrying out the voice assessment in this study were from Western culture, it is likely that they perceived the participant children's voices according to Western concepts of 'normal' and 'abnormal' voice quality. It may be, therefore, that, had the judges been of different cultural origins, the participant children's vocal health may have been categorised differently. For example, children of specific origins (such as African origin) may not necessarily have been perceived as exhibiting unhealthy vocal characteristics. Therefore, an additional study with judges from different cultural backgrounds should be conducted in order to investigate potential connections between cultural background factors and the child voice (see Chapter 11).

Nevertheless, it should be noted that general trends in the child voice data were recorded across the participant population despite the children's cultural backgrounds. A degree of hoarseness, breathiness and vocal fry in the 10-year-old participants' voices were common. The findings, therefore, provided support for previous studies that claimed that it was 'normal' for 10-year-old children exhibit a degree of hoarse and rough voice quality (McAllister, 1997; Sederholm, 1996). Nevertheless, age-differences were recorded since the 7-year-old participants generally exhibited healthy and clear voice quality. The differences recorded between 10-year-olds and 7-year-olds' vocal products may have manifested due to the fact that, as the children approached pubertal age, they are more likely to exhibit unhealthier voice quality, as a result of the underlying physiological changes taking place in their voice mechanism (Hunt and Slater, 2003; Mathieson and Greene, 2003; Welch and Howard, 2002; Williams et al., 2005). In addition, older children would have been exposed to cultural-conditioning for a longer period of time. with their local cultural factors having considerably shaped their vocal behaviours. Older children may have also been engaged in hobbies (such as sports) that required a greater amount of voice use, whereas their younger peers may have chosen more solitary hobbies. It may also be that older children may simply have used their voices for longer periods of time than their younger peers (McAllister, op.cit.; Sederholm, op.cit.).

The above discussion indicates that sociological factors are connected to children's speaking and singing behaviours. It seems that the 'normality' and 'abnormality' of the

199

child voice is culturally-located. Nevertheless, the findings from this study are tentative and a more comprehensive, systematic study is needed for investigating the implications further (see Chapter 11).

10.2.1 Cultural shaping of specific voice parameters

Specific voice parameters in children's speaking and singing behaviours have not been exposed to extensive investigation within a particular culture nor across cultures (Andrews, 1991; Carding et al., 2003; Wilson, 1987). Therefore, it is not known whether the same voice parameters are dominant features of the child voice across cultures (Welch and Howard, 2002; Welch, 2005). Although the current study indicated that the dominant voice parameters in children's speaking behaviour were similar to those in their singing behaviour, some difference was recorded between the two vocal behaviours. Specific voice parameters (such as vocal fry and unstable pitch) were more dominant in the participant children's singing behaviour than in their speaking behaviour. It may be that the distinct natures of the two vocal behaviours facilitated such dominant features (Bunch, 1997; Thurman, 2000). For example, functional aspects of singing behaviour may have enabled the judges to perceives unstable pitch easier in this vocal behaviour than in speaking behaviour (Welch, 1985; Williams et al., op.cit.).

Further evidence for the role of each vocal behaviour as to shaping children's vocal output was gathered from the finding that, when a child had been engaged in singing more extensively, specific voice parameters (such as hoarseness and hyperfunctioning) were less likely to be perceived as unhealthy or 'abnormal'. Alternatively, it may be that the children whose voice quality was less hoarse were more likely to engage in singing than those children whose voice was hoarser.

It may be that, since children spend a greater amount of their time speaking than singing, habituated voice production techniques may have been adopted to the former vocal behaviour, reflected in the children's speech and further in the recorded differences between the two vocal behaviours. For instance, the children may have forced their voices more when speaking than when singing, deteriorating their vocal health in the former vocal behaviour, but not in the latter. Such habituated techniques may be culturally-located, with different cultures shaping individual voice parameters in unique ways.

It may be that external factors interfered with the judges' perceptions of the children's vocal output (Baker, 2002a; b; Hunt and Slater, 2003; Mathieson and Greene, 2003; McAllister, 1997; Sederholm, 1996; Sundberg, 1996; 2001; Thurman and Welch, 2000). For example, excess mucosa caused by external pollutants may have influenced the children's vocal health and voice quality in their speaking behaviour to a greater extent than in their singing behaviour, resulting in perceptual differences between the two vocal behaviours. Psychological factors (such as negative associations with singing activities) may also have interfered with the children's final vocal products. It may be difficult to point out the exact causal factor for such differences, but the findings indicate that factors from the children's local environment played a considerable role.

Furthermore, cultural variation was recorded in the quality of specific voice parameters. Cultural differences in the quality of individual voice parameters were more evident in speaking behaviour than in singing behaviour. For English children, hyperfunctioning (further associated with hoarseness, roughness and breathiness) was relatively common in the children's speaking behaviour. For Finnish children, hypernasality was relatively common in the children's speaking and singing behaviours. The findings indicate that considerable differences may be recorded in the quality of individual voice parameters according to the children's cultural background. As discussed in section 10.2, factors from the children's culture and mother-tongues may have facilitated such differences in the children's general voice quality and in the individual voice parameters in their voices. Nevertheless, hyponasality and hypofunctioning were perceived as the healthiest characteristics and hoarseness and breathiness were perceived as the unhealthiest characteristics, in both vocal behaviours despite the cultural origin of the children.

Furthermore, previous research has indicated that specific voice parameters may be closely connected to voice parameters in children's speaking behaviour (McAllister, 1997; Sederholm, 1996). Perceived hoarseness, roughness, hyperfunctioning and breathiness have been found to form considerable relationships with one another (McAllister, op.cit.; Sederholm, op.cit.). For example, when a child is perceived as exhibiting a degree of hoarseness, the child's voice is also likely to be perceived as rough (McAllister, 1997;

201

Sederholm, 1996). The findings from the current study supported such claims in terms of both speaking and singing behaviours. A number of significant relationships were recorded between different voice parameters. In particular, hyperfunctioning and harsh voice quality (i.e. hoarse or rough voice quality) appeared to be connected in the children's speaking and singing behaviours, despite the cultural origin of the children. In addition to the recorded general trends, the relationships varied across the four small groups (see Appendices 2-5), indicating that sociological factors may play a role in facilitating such relationships. In such relationships, it may be difficult to determine which voice parameter is primarily influencing which. For example, it may be that a hyperfunctional voice production technique is causing a child's voice to be hoarse. Alternatively, it may be that hoarse voice quality facilitates hyperfunctional voice production techniques. Nevertheless, cultural factors seems to be linked to all voice parameters.

It should be noted that considering additional voice parameters to the ones included in the study may highlight additional dominant features of the child voice. However, since the voice assessment method adopted to this study was relatively comprehensive, it is likely that it covered the most dominant vocal characteristics.

10.3 One voice

The traditional concept has been that children possess 'a speaking voice' used for generating speaking behaviour and 'a singing voice' used for generating singing behaviour (Rinta and Welch, 2008a; Sundberg, 2001; Thurman and Welch, 2000; Welch, 2005). The voice-scientific perspective, however, has advocated the idea that children possess one voice that is used for generating all vocal behaviours (including their speaking and singing behaviours) (Sundberg, 1996; op.cit.; Thurman and Welch, op.cit.). Support for the voice-scientific perspective has been derived from the fact that the same physiological elements (i.e. the voice mechanism) generate all vocal behaviours (see Chapters 2 and 3) (Bunch, 1997; David, 1995; Mathieson and Greene, 2003; Reid, 2001; Rubin et al., 2003; Sundberg, op.cit.; Thurman and Welch, 2000).

Similarly, the evolutionary perspective claims that all vocal functioning have relied on the same primary instrument for centuries (Newman, 1986; Thiessen, 1996). Speaking and

202

singing behaviours commenced to be perceived as distinct from one another only later on in time due to societal and cultural ideas that further facilitated the concept of 'a speaking voice' and 'a singing voice' (Brown et al., 2004; Bruyninck et al., 1994; Fourcin, 2005; Hewstone et al., 1996; Lamont, 2002; Papousek, 1996; Rubin et al., 2003; Ruzza et al., 2002; Welch, op.cit.). The current study provided evidence for such ideas by indicating that children possess one voice that is used for generating their speaking and singing behaviours. Perceptual similarities between the two vocal behaviours were recorded as to the vocal characteristics both of the behaviours relied on, despite the cultural origin of the children (see Chapter 6). Even when cultural differences were recorded in the voice quality ratings, such differences were simultaneously recorded in both speaking and singing behaviours.

Since the findings from the study indicated that children's vocal functioning and voice quality did not differ significantly from one vocal behaviour to another, further evidence was gathered for the claim that children's cultural and societal environment educate children to perceive their 'speaking voice' and 'singing voice' as two distinct entities (Birkenshaw-Flemming, 1989; Dobbs, 1990; Laurence, 1999; Lohmander et al., 1998; McMullen and Saffron, 2004; Sell, 2005; Sloboda, 2000; Stacy et al., 2002; Sloboda, 2000; Welch, 2005). It may be that different cultural perceptions of speaking and singing behaviours have facilitated such concepts of 'speaking' and 'singing' voices. For instance, in Africa, singing is generally perceived to be a natural activity for anyone to engage in, whereas in Western culture, singing activities are not always fostered in the same way. It may be that, particular cultures (such as Western culture) foster an inappropriate idea of children possessing 'a speaking voice' and 'a singing voice'. The deep-rooted cultural ideas as to the two different types of voices are subsequently reflected in educational and therapeutic practice through facilitating the concept of us possessing 'a speaking voice' and 'a singing voice'.

Finally, it should be emphasised that children's speaking and singing behaviours have not been exposed to such an in-depth enquiry in previous studies. No other study has simultaneously investigated children's vocal functioning and voice quality in their speaking and singing behaviours. Therefore, the findings provide considerable implications as to children possessing one voice that used for generating both vocal behaviours. A larger-scale, cross-cultural study relying on both perceptual and acoustic voice analyses should be conducted in order to investigate the findings further (see Chapter 11). The combination of the assessment approaches would enable one to draw clearer connections and distinctions between the two vocal behaviours.

10.3.1 Summary

In summary, the discussion indicates that children possess one voice that is used for generating their speaking and singing behaviours. The discussion indicates that it is appropriate to talk about speaking and singing behaviours, but not 'speaking' and 'singing voices'. The 'normal' and 'abnormal' characteristics of children's speaking and singing behaviours appear to be culturally-located. Such cultural characteristics can be recorded in general voice quality, as well as in individual voice parameters.

10.4 Holistic factors in practice

It has been claimed that children's speaking and singing behaviours are simultaneously shaped by a variety of factors (such as those of physiological, psychological and sociological origins) (Baker, 2002a; b; Brown et al., 2004; Hunt and Slater, 2003; Mathieson and Greene, 2003; McAllister, 1997; Rubin et al., 2003; Sederholm, 1996; Welch, 2005) (see Chapter 2 and 3). More specifically, the physiological mechanisms that generate all vocal behaviours are linked to children's psychological sides through complex neural networks, with all such factors further being connected to sociological factors (Pert, 1986; Thurman and Welch, 2000). For example, inefficient vocal production techniques in combination with a depressive psychological state may simultaneously contribute to children's unhealthy output (Mathieson and Greene, op.cit.; McAllister, op.cit.; Sederholm, op.cit.). Each perspective is considered below. Evidence for a variety of holistic factors was gathered from the current study.

10.4.1 Physiological mechanisms

According to the voice-scientific and the evolutionary perspectives, children's speaking and singing behaviours are generated by the same physiological mechanisms (i.e. the voice mechanism and other physiological systems connected to it) (Bunch, 1997; Reid, 2001; Thomasson, 2003; Sundberg, 1996; 2001). For example, the mouth and the lips are needed for generating all vocal output, with inefficient use of these particular mechanisms potentially leading to disfluency speech disorders (such as stuttering) (Reid, op.cit.). In relation to such claims, it has been argued that the main differences recorded between speaking and singing behaviours derive from recorded functional differences between the two vocal behaviours rather than structural differences in the physiological elements underlying the vocal behaviours (Bunch, op.cit.; David, 1995; Rubin et al., 2003).

The current study did not focus on exploring specific physiological mechanisms underlying children's speaking and singing behaviours since the aim of the study was to explore a variety of factors influencing children's speaking and singing behaviours, with emphasis being placed on investigating the similarities and differences between the two vocal behaviours. In addition, it was not feasible to carry out such an extensive medical study due to time and financial constraints. Nevertheless, the findings supported the claims that the same voice is used in generating speaking and singing behaviours (see Section 10.2). Therefore, it can be assumed that the one voice relies on the same physiological structures as its initial source for the voice and, therefore, the same physiological structures underlie both vocal behaviours. It is likely that, were speaking behaviour generated by different physiological mechanisms than singing behaviour, the final vocal output would differ perceptually between the two vocal behaviours. The differences recorded between individual voice parameters in speaking behaviour and those in singing behaviour may have derived from different ways of using the same physiological mechanisms rather than different underlying physiological mechanisms (see Section 10.2.1).

The child voice mechanism is further connected to other physiological systems (such as the immune system) via a complex neurological network (Baker, 2002a; b; Colton and Casper, 1996; Hunt and Slater, 2003; Mathieson and Greene, 2003; Thurman, 2000) (see Chapter 3). Imbalances in any of the connected physiological systems are, therefore, likely to be shaping the children's vocal output (Mathieson and Greene, op.cit.; Thurman, op.cit.). For instance, external bacteria in a child's throat or a hormonal disturbance may possess a deteriorating effect on the child's vocal output (Bastian et al., 2000). The current study supported such claims since the participant children perceive differences in their voice production process when external irritants (such as pollutants) were

205

disturbing their voice production process (see Chapter 8). For example, when a child had a sore throat, the child was likely to report tension in their voice mechanism. Such findings suggest that the physiological mechanisms underlying voice production in both vocal behaviours are susceptible to external irritation, which may subsequently interfere with their voice production process.

Further support for connections between physiological mechanisms underlying the two vocal behaviours was derived from the participant children's subjective experiences and opinions. A significant number of the children stated that they felt discomfort, physiological tension and difficulties in their voice production in both vocal behaviours. Such self-perceived statements indicated that the same physiological mechanisms underlay the two vocal behaviours.

Nevertheless, a sub-set of the participant children may have perceived differences in the two vocal behaviours due to the different perceived demands of the two vocal behaviours (David, 1995; Rubin et al., 2003). The children who stated that they felt discomfort when singing but not when speaking may have used an excessive amount of force during voice production when singing, subsequently resulting in physiological tension in the voice mechanism and in distorted vocal output (Williams et al., 2005). Alternatively, it may be that the skills required for generating each vocal behaviour facilitated differences in their subjective experiences (Bunch, 1997; Rubin et al., op.cit.). It should be noted that children who had been engaged in singing more extensively were likely to state that their speaking and singing behaviours originated from the same physiological source. Therefore, it may be that, as a result of their singing engagement, the children become more aware of the underlying physiological connections that link the two vocal behaviours to one another.

In addition, the hearing mechanism plays a significant role in correcting and modifying children' speaking and singing behaviours (Brestovci and Bolfan-Stosic, 1998; Bunch, 1997; Fourcin, 2005; Thurman and Gramsch, 2000). Therefore, children's voice production techniques can potentially be facilitated through raising their awareness of vocal production techniques, for instance, through singing (Bunch, op.cit.). Such awareness is likely to have a significant effect on a child's general voice production

206

techniques and their ability to modify their voice production, further being reflected in their vocal output.

The discussion above is only tentative, however, and physiological mechanisms underlying children's vocal behaviours need to be exposed to further research. A comprehensive, systematic study specifically investigating physiological correlates behind children's speaking and singing behaviours could highlight further similarities and differences between the voice production processes underlying children's speaking and singing behaviours (see Chapter 11).

10.4.1.1 Development of physiological mechanisms

The physiological mechanisms underlying children's voice production differ considerably from those of adults (Hunt and Slater, 2003; Mathieson and Greene, 2003; Sapienza and Hoffman, 2001; Stathopoulus, 1998; Whiteside and Hodgon, 1999). The child voice mechanism is immature, with gradual physiological changes taking place as the child matures (Stathopoulus, op.cit.; Welch and Howard, 2002). Changes in vocal output become particularly noticeable as the child approaches pubertal age (Welch and Howards, 2002). The current study indicated that age is connected to children's vocal output. More specifically, 10-year-old children exhibited a greater amount of perceived 'abnormal' voice quality than their 7-year-old peers did in both vocal behaviours. For example, older children were more likely to exhibit unhealthily hyperfunctional characteristics than their younger peers were (see Appendices 2-5). The recorded differences were likely to derive from changes taking place in the physiological mechanisms required for voice production (see Section 10.2.1). It may be that such unhealthy characteristics diminish once children pass pubertal age and their physiological mechanisms have reached their final shape.

Furthermore, children's cultural and societal surroundings shape the children's vocal behaviours throughout their lives (Mathieson and Greene, 2003; Welch, 2005), suggesting that older children will have been exposed to such cultural conditioning for a longer period of time than their younger peers. Evidence for the accumulative societal shaping and physiological changes was found from the current study since that minimal age-differences (i.e. less than one year) did not highlight significant differences in the children's vocal products, whilst greater age-differences did (i.e. great than one year) (see Appendices 2-5). It may be that an interaction takes place between physiological and sociological factors that further connected to children's vocal output, with greater differences in age being reflected in greater perceptual differences between the children's vocal behaviours.

Furthermore, it has been claimed that speech, voice and singing disorders are connected to one another (Hunt and Slater, 2003; Koivusaari, 1998; McAllister, 1997; Rubin et al., 2003). In the current study, a relatively high percentage (58 %) of the participant children who possessed a speech disorder also exhibited a voice distortion in either or both vocal behaviours. The finding indicates that all of such disorders may be connected through their underlying physiological mechanisms that generate the main instrument (i.e. the voice) (Mathieson and Greene, 2003; Rinta and Welch, op.cit.; Thurman and Welch, 2000). Therefore, some indication for the effect of changes taking in the underlying physiological mechanisms is derived, although such physiological correlates should be exposed to further investigation in a subsequent study.

10.4.2 The 'bodymind'

The physiological mechanisms underlying children's speaking and singing behaviours are connected to psychological factors through a complex neural network (see Chapter 3) (Pert, 1987; Rinta and Welch, 2008a; Thurman and Welch, 2000; Welch, 2005). Such an integrated body and mind entity has been referred to as 'the bodymind' (Pert, op.cit.). The neurological network, which connects the different components of 'the bodymind' to each other, consists of the brain and a set of neural systems (Baker, 2002a; b; Colton and Casper, 1996; Hunt and Slater, 2003; Mathieson and Greene, 2003; Thurman, 2000). In the current study, neurological processes underlying children's speaking and singing behaviours were not specifically investigated due to technical, ethical and time constraints that such an investigation requires (Peretz and Coltheart, 2003; Zatorre, 2005). Moreover, the intention of the study was not on identifying exact neurological processes underlying children's speaking and singing behaviours, but the focus was on exploring a variety of factors (such as those of psychological origin).

Nevertheless, evidence for potential connections between children's physiological and psychological sides was derived from the study. An example for such an indicative connection was a finding from the psychological perspective that suggested that children's reported feelings of well-being increased subsequent to a singing session (see Chapter 8). It may be that the neural networks that connect a child's mind their body are stimulated through singing engagement, subsequently facilitating feelings of well-being. When a child's 'bodymind' is stimulated, positive development is likely to be recorded in the child's physiological and psychological sides (Pert, 1986; Thurman and Welch, 2000; Welch, 2005). Particularly those children who had been engaged in singing on a regular basis reported to have experienced enhanced feelings of well-being from both a physiological and a psychological perspective, further suggesting that children's bodies and minds are connected.

For a considerable number of the participant children, feelings of psychological well-being were connected to healthier vocal products, as also suggested by previous studies (Bolfan-Stosic et al., 20003; Koivusaari, 1996; Mathieson and Greene, 2003). The discussion, therefore, suggests that there is a network of physiological and psychological factors in operation that are connected to children's speaking and singing behaviours. The above discussion provides tentative support for the 'bodymind' connection, but the 'bodymind' concept needs to be exposed to further investigation in a subsequent study (see Chapter 11).

10.4.3 Connections between psychological factors

A limited number of studies have investigated psychological factors connected to children's speech and voice disorders (Andrews, 1991; Baker. 2002a; Beck et al., 2000; Deem and Miller, 2000; Hunt and Slater, 2003; Mathieson and Greene, 2003; Unwim et al., 2002; Valentine, 2001), despite the fact that our voices are intimate parts of ourselves and disturbances in our voice production are likely to deteriorate our psychological well-being (Baker, 2002b). Nevertheless, a few studies have indicated that learning and behavioural difficulties, personality characteristics and vocal identity are connected to children's voice quality in their speaking behaviour (Aronson, 1985; Baker, op.cit.; Butcher et al., 1987; Horsley and FitzGibbon, 1987; Koivusaari, 1998; Sederholm, 1996;

209

Virokannas, 1997). For example, stuttering has been connected to poor self-esteem, further affecting the individual's ability to learn (Koivusaari, op.cit.).

The current study supported the previous findings by further indicating that a variety of psychological factors are connected to children's singing behaviour. The specific psychological factors that were connected to the participant children's speaking and singing behaviours were: a) vocal identity; b) personality factors; c) behavioural and learning difficulties; and d) biography.

10.4.3.1 Vocal identity

Vocal identity (i.e. the ability to identify with one's own voice) is considered to be a crucial element in facilitating healthy vocal development (Bolfan-Stosic et al., 2003; Hunt and Slater, 2003; Mathieson, 2000; Rinta, 2008). The ability to identify with one's own voice is essential in monitoring voice use, modifying one's voice production technique and in using one's voice in a confident way when communicating with other (Bolfan-Stosic et al., op.cit.; Mathieson and Greene, 2003). When a child is able to identify with their voice in both vocal behaviours, appropriate vocal awareness is facilitated, further resulting in enhanced vocal output in all vocal behaviours (Bolfan-Stosic et al., 2003; Rinta, 2008).

When children have been educated on perceiving their 'speaking' and singing voices' differently, they may have developed different ways of identifying with their voices depending on the vocal behaviour they are engaging in (Laurence, 1999; McMullen and Saffron, 2004; Sloboda, 2000; Welch, 2005). For instance, a child may be able to identify with their voice when speaking, but not when singing (Rinta and Welch, 2008b). It may be that some cultures facilitate the ability to identify with one's voice differently according the vocal behaviour they are being engaged in. The current study provided further support for the idea of children identifying differently with their voices in their speaking behaviour and their singing behaviours. It may be that the traditional ideas advocating the concepts of 'speaking' and 'singing voices' as separate entities have encouraged children to identify with their 'speaking' and 'singing voices' differently.

The concepts of 'speaking' and 'singing voices' as separate entities, as well as speaking and singing behaviours as two completely different sets of behaviours, were reflected in the responses derived from the children when enquired abut their vocal identity (se Chapter 8). The majority of the children identified with their 'singing voice' more positively than they did with their 'speaking voice'. It may be that the children had learnt to pay more attention to their voice when singing than when speaking, subsequently facilitating more positive vocal identity for the former vocal behaviour than for the latter. It may also be that, since the children's voice quality was generally healthier in their singing behaviour than in their speaking behaviour, the children may have identified with their voice in the former behaviour more positively than in the latter, subsequently being reflected in their vocal identities. Singing could, therefore, potentially be exploited as a tool to facilitate positive vocal identity development, subsequently being reflected in enhanced vocal output. Moreover, since the current study indicated that children possess one voice, rather than 'a speaking voice' and 'a singing voice', positive overall vocal identity could be facilitated through educating children in perceiving their voices in similar ways in both vocal behaviours (see Section 10.2).

In summary, the current study suggested that vocal health and vocal identity were connected since healthy voice quality was associated with positive vocal identity and unhealthy voice quality was associated with negative vocal identity. It may be that a poor vocal identity has a negative influence on children's vocal behaviours and products. Alternatively, it may be that unhealthier vocal output has a negative impact on vocal identity. It may also be that unhealthier voice quality has a deteriorating effect on children's psychological well-being, subsequently having a detrimental effect on the children's vocal identity.

Although it may be that cultural norms and different forms of singing engagement shape children's vocal identities differently, minimal cultural variation was recorded in the participant children's vocal identities. A comprehensive, cross-cultural study specifically investigating such aspects should be conducted in order draw any firm conclusions from the tentative findings presented here (see Chapter 11).

211

10.4.3.2 Personality characteristics

Personality characteristics have been connected to children's voice quality in their speaking behaviour (Baker, 2002a; Horsley and FitzGibbon, 1987; Roy et al., 2006; Virokannas, 1997). For example, voice quality in speech have been found to differ significantly between introverted and extroverted children (Baker, op.cit.; Roy et al., op.cit.). It is not known, however, whether personality characteristics primarily influence children's vocal behaviours and products, or whether children's vocal output primarily shapes their personality development. It may also be that the interaction takes place in both directions. Similarly, it is not known whether the relationship between personality characteristics and voice quality varies from vocal behaviour to vocal behaviour, or from culture to culture.

The current study suggested that personality characteristics were linked to children's speaking and singing behaviours. However, such findings were applicable only to children of specific cultural origins. In Britain, extraverted and hyperactive children were more likely to exhibit unhealthier voice quality when compared to their introverted and shy peers. On the other hand, in Finland, extraverted and hyperactive children did not differ from their introverted and shy peers in terms of their voice quality. The finding was applicable to both speaking and singing behaviours. Sociological factor are, thus, likely to facilitate the relationship between children's vocal health and their personality characteristics. It may be that Scandinavian culture is more reserved than British culture, due to which the extraverted characteristics exhibited by children in the former culture were not as extreme as those exhibited in the latter culture and, therefore, did not pose as deteriorating an effect on the children's voice quality. It may also be that the vocal output exhibited by British children had a greater impact on their personality development in comparison to the children in Finland. Alternatively, it may be that the local culture in Finland did not facilitate the children's extraverted personality characteristics as greatly as the culture in Britain, diminishing their relationship with the children's voice quality.

The findings, therefore, suggest that additional internal or external factors are needed in order for significant relationships to be recorded between children's personality characteristics and their vocal health. It may be that environment at home and at school in Britain encourages children to exhibit extraverted behaviour that, subsequently, results in voice abuse and causes children's vocal health to deteriorate. In Finland, on the other hand, the local culture may inhibit children from abusing their voices, in turn preventing their vocal health from deteriorating despite their extraverted personality characteristics.

Moreover, it may be that different concepts of extraversion and introversion operate in Finland than in the UK. For instance, it may be that, due to the more reserved Scandinavian culture, children are more easily perceived as extraverted in Finland when they exhibit even slightly extraverted personality characteristics, whereas in the UK, children need to exhibit more severe forms of extraversion in order to be classified as extraverted individuals.

Furthermore, children demonstrating different personality characteristics have been found to engage in different types of extra-curricula activities (McAllister, 1997; Sederholm, 1996). For example, extraverted individuals are often more likely to participate in sports, whereas introverted individuals are more likely to undertake more solitary activities (McAllister, op.ci.t). The findings from the current study supported such claims by indicating that children who perceived themselves as extraverted and hyperactive were more likely to engage in active leisure-time activities in comparison to children who perceived themselves as introverted and shy (see Chapter 8). Such connections were further associated with vocal health since the former group was more likely to exhibit unhealthier vocal output than the latter group.

Similarly, personality characteristics of singers have been found to differ from those of non-singers (Timmermans et al., 2004). In the current study, children with extraverted tendencies were also more likely to engage in singing activities than their introverted peers. The former group were also more likely to exhibit unhealthier vocal output than the latter (see Appendix 2). Therefore, it may be that singing training facilitates personality development and personality characteristics subsequently deteriorate children's voice quality. Alternatively, it may be that the children's innate extraversion tendencies encourage them to engage in singing. It may also be that the children's voice quality shaped their personality characteristics and further their decision as to the activities they chose to engage in.

213

The above discussion suggests that there is a network of factors in operation Personality characteristics appear to be connected to children's speaking and singing behaviours. However, additional factors (such as those from local culture) are needed for facilitating such relationships.

10.4.3.3 Behavioural and learning difficulties

Whilst being connected to children's vocal behaviours, personality characteristics have been associated with behavioural patterns (Aronson, 1985; Baker, 2002a; Butcher et al., 1987; Horsley and FitzGibbon, 1987; Koivusaari, 1998, Sederholm, 1996; Virokannas, 1997). Simultaneously, behaviour exhibited by children has been linked to children's vocal healt (FitzGibbon, op.cit.; Koivusaari, op.cit.; Virokannas, op.cit.). Furthermore, behavioural and learning difficulties have been connected to speech and voice distortions in children's speaking behaviour (Coster et al., 1999; Koivusaari, 1998; Roy et al., 2006; Virokannas, 1997). For example, when a child is perceived as having dyslexia, the child is more likely to possess a speech or a voice disorder than their peers who exhibit 'normal' reading development (Koivusaari, op.cit.; Virokannas, op.cit.). The current study provided support for such claims by indicating that children's vocal products in their speaking and singing behaviours were connected to specific behavioural and learning difficulties.

For speaking behaviour, a particularly strong relationship was recorded between vocal distortions in the participant children's speaking behaviour and their reading difficulties. The finding indicates that speaking and reading behaviours may rely on the same processing systems, as suggested by previous studies (Koivusaari, 1998; Virokannas, 1997). It may be that these two behaviours rely on the same linguistic processing systems (such as the phoneme-processing sub-system) (Peretz and Coltheart, 2003). It may be that these linguistic-processing systems have not been fully-developed in individuals who exhibit reading difficulties, potentially interfering with the child's voice production process (such as through excessive pressure placed on the child's voice mechanism when speaking) and resulting in deteriorated vocal output. Alternatively, it may be that unhealthier voice quality interferes with a child's reading ability. It may also be that an additional factor (such as the child's first language) simultaneously influences the child's ability to speak and to read, posing a deteriorating effect on the child's vocal health.

214

Nevertheless, identifying one difficult (such as speech disorder) may aid in identifying other difficulties (such as dyslexia) as early on as possible and prevent such difficulties from developing into unmanageable forms.

For singing behaviour, evidence was found for a relationship between vocal distortions in singing and speech disorders. Although it has been claimed that speech disorders and vocal distortions in children's speaking behaviour are often connected (Rinta, 2008; Rinta and Welch; 2008a; Rubin et al., 2003), the current study suggested that speech disorders were connected to the participant children's vocal output in their singing behaviour rather than their speaking behaviour. It may be that speech disorders interfere with children's voice production when singing, further posing a deteriorating effect on their vocal output in their singing behaviour. Alternatively, it may be that unhealthier voice quality in children's singing behaviour possesses a negative influence on the children's speaking behaviour. It may also be that a third factor (such as cultural ideas associated with singing behaviour) simultaneously influences the children's speaking behaviour and voice quality in their singing behaviour. Furthermore, children may have adopted different techniques to their voice production when singing than when speaking and, therefore, singing behaviour may highlight aspects of the children's vocal functioning that speaking behaviour does not illustrate. In relation to this, it may be easier to diagnose particular types of vocal distortions through focussing on singing behaviour rather than speaking behaviour.

It has been claimed that, when a child possesses a speech disorder, the child is likely to produce their voices inefficiently, subsequently interfering with their voice quality (Andrews, 1991; Mathieson and Greene, 2003; Rinta, 2008). The study supported such claims by indicating that the more severe a child's speech disorder is, the more likely the child is to exhibit vocal distortion in their speaking behaviour. In fact, only more severe vocal distortions were connected to speech disorders. The finding, therefore, suggests that more extreme speech disorders possess stronger connections with vocal distortions in children's speaking behaviour, whilst minor speech disorders may not necessarily form such strong connections with vocal distortions.

Despite the fact that previous studies have indicated that behavioural difficulties are connected to vocal distortions in children (Aronson, 1985; Baker, 2002a; McAllister,

215

1997; Sederholm, 1996), the current study only provided minimal evidence for such claims. It may be that additional factors (such as those form local culture) are needed for facilitating a relationship between behavioural difficulties and voice distortions. For example, interaction between parents, teachers and the child, who possesses a diagnosed behavioural difficulty, is likely to be reflected in the child's psychological well-being and subsequently in their vocal health. It may also be that specific behavioural difficulties (such as hyperactive-tendencies) primarily facilitate voice abuse and result in voice distortions, as suggested by the findings indicating a relationship between personality characteristics and voice distortions (see Section 10.4.3.2). Therefore, it may be that the types of behavioural difficulties that were part of the current study may have biased the outcomes of the study.

The above discussion indicates that a stronger connections can be recorded between children's speaking behaviour and their learning and behavioural difficulties, rather than between their singing behaviour and such difficulties. It may be that, since children spend a greater deal of their time speaking than singing, it is more likely that learning and behaviour difficulties form connections with the former vocal behaviour than the latter. It may also be that, since singing engagement may have a facilitative effect on children, singing behaviour may diminish the negative effect of learning and behavioural difficulties on children and, therefore, as strong connections are not recorded as to children's singing behaviour and such difficulties.

Based on the above discussion, it seems that there is a complex network of psychological factors in operation that is further connected to children's vocal health in their speaking and singing behaviours. The network appears to be connected to sociological factors (such as children's living environment). The factors interact through a variety of routes and it may be, therefore, difficult to identify which factor is primarily influencing which in such a network. For instance, it may be that a child's speech disorder is causing the child's learning or behavioural difficulty to exhibit itself. Alternatively, it may be that a behavioural or learning difficulty possesses a negative impact on a child's psychological state and well-being, further deteriorating the child's vocal health in the child's speaking behaviour. It may also be that a third factor (such as the daily living environment) is simultaneously influencing the child's psychological well-being and vocal output.

216

10.4.3.4 Biography

Previous studies have provided indication for a connection between biography (i.e. self-identity, self-esteem and self-efficacy) and children's speaking behaviour (Baker, 2002b; Bolfan-Stosic et al., 2003; Kersner and Wright, 2002; Rinta and Welch, 2008a). Biographic perceptions have been associated with psychological well-being and with vocal health (i.e. more positive biographic perceptions were connected to better psychological well-being, as well as healthier voice quality) (Bolfan-Stosic et al., op.cit.; Koivusaari, 1998; Rinta, 2008). The current study supported such claims. The findings indicated that the unhealthier a child's vocal output was in either or both vocal behaviours, the poorer the child's biographic perceptions were likely to be (such a slower self-esteem and poorer feelings of self-efficacy).

More specifically, children with poorer vocal health exhibited lower levels of self-confidence and self-esteem, as well as poorer self-identity in comparison to their peers with better vocal health. More severe forms of vocal distortions formed stronger connections with children's biographic perceptions (i.e. more severe forms of vocal distortions were connected to more negative biographic perceptions). The findings indicated that, the better a child feels about their voice, the better the child felt about themselves. It may be difficult to know the nature of the interaction taking place (i.e. whether biography primarily influences children's vocal health or whether vocal health primarily influences their biographic perceptions). There may also be a third factors (such as feedback received from other in social situations) that is simultaneously influencing the child's biographic perceptions and their vocal health.

Furthermore, it has been suggested that singing has a facilitative effect on adult's biographic perceptions (Grape et al., 2003; Clift and Hancox, 2001). For instance, singing engagement has been associated with elevated levels of self-confidence and self-efficacy (Bailey and Davidson, 2005; Clift and Hancox, op.cit.; Grape et al., op.cit.). The findings from the current study indicated that such findings were applicable to children. Those children who had undergone more extensive singing training and, subsequently, were more likely to exhibit healthier voice quality demonstrated higher levels of self-confidence and self-efficacy than those children who had not undergone as extensive singing training. Therefore, singing engagement can potentially facilitate positive biographic feelings. It may also be that children holding more positive biographic feelings are likely to exhibit healthier vocal output. Alternatively, it may be that an additional factor (such as home environment) may simultaneously be influencing children's vocal output and their biographic feelings.

The above discussion indicates that it may be that biographic perceptions and children's vocal health are connected to their general psychological well-being (Rinta and Welch, 2008a; Rinta, 2008). Furthermore, it may be that singing engagement possesses a positive effect children's psychological well-being, further being reflected in their biographic perceptions and vocal output. The exact interaction between the different factors may be difficult to determine and needs to be exposed to further investigation in a subsequent study (see Chapter 11).

10.4.3.5 Psychological aspects of singing

In relation to the discussion in the above section, it has been suggested that positive development can be facilitated in adults' psychological side through singing engagement (Andrews, 1991; Baars and Gabrielsson, 1997; Beck et al., 2000; Baroni et al., 1997; Bunch, 1997; Deem and Miller, 2000; Grape et al., 2003; Mendes et al., 2004; Silber, 2005; Stacy et al., 2002; Ternstrom, 2002; Thurman and Welch, 2000 Unwim et al., 2002; Valentine, 2001; Welch, 2005). For example, enhanced feelings of well-being has been recorded subsequent to singing sessions (Bailey and Davidson, 2005; Clift and Hancox, 2001; Grape et al., op.cit.). The positive influences of singing have further been associated with enhanced psychological and sociological functioning (such as the ability to learn or the ability to communicate in a group-setting) (Mathieson and Greene, 2003; Sederholm and McAllister, 1997; Unwim et al., op.cit.). The current study indicated that children associated singing with positive functions. More specifically, the participant children generally perceived singing as a calming and relaxing activity that facilitated feelings on happiness. In particular, those children who had been engaged in singing on a regular basis associated strong positive functions with such activities. Familiarity with singing activities, therefore, appeared to play an important role in shaping the children's perceptions of such activities.

Moreover, children's vocal behaviours and products have been found to be sensitive to their affective states (Bolfan-Stosic et al., 1998; Butcher et al., 1987; Laukka, 2004; Leppanen and Hietanen, 2001; Sundberg, 1987). Given that singing appeared to be connected to positive affective states in children (Davis et al., 1999; Davis, 2005), singing could potentially be used as means to facilitate psychological well-being in children (Clift and Hancox, 2004). Subsequently, enhanced feelings of psychological well-being are likely to be reflected in children's general behavioural and learning patterns (Koivusaari, 1998; Rinta, 2008; Virokannas, 1997), as well as their vocal health.

Further evidence for the positive effect of singing was derived from the fact that subjective perceived enjoyment of singing activities and children's vocal health appeared to be connected. More specifically, the children who enjoyed singing were more likely to exhibit healthier voice quality than those children who did not perceive singing as positively. Alternatively, it may be that children who exhibited healthier voice quality were more like to perceive singing activities more positively, whilst children who exhibited unhealthier voice quality were more likely to perceive singing more negatively. It may also be that singing training influences children's perception of such activities, as well as their vocal functioning and vocal behaviours. Alternatively, it may be that singing training enhances children's vocal health. Such a network of factors would need to be exposed to a systematic investigation in a subsequent study (see Chapter 11).

Moreover, the music education a child ahs received and the child's exposure to musical activities (including singing) are likely to shape the child's perceptions of such activities (Bunch, 1997; Welch, 1994). The current study suggested that singing engagement may influence a child's decision as to whether to engage in other musical hobbies, as well as their enjoyment of such hobbies. Alternatively, it may be that children who participate in additional musical and performing arts hobbies are more likely to undertake singing activities. Nevertheless, there appears to be a network of psychological factors in operation that determine children's perceptions and attitudes to singing and to other musical activities. It may also be that additional factors (such as norms operating in the children's culture) shape children's perceptions of such activities, as well as their vocal output.

219

It should be noted that a significant number of the children who participated in the current study possessed slightly healthier voice quality in their singing behaviour than in their speaking behaviour. The finding, therefore, supports previous studies advocating the idea that children's vocal health is likely to be better in their singing than in their speaking behaviour since the former behaviour specifically focusses on enhancing voice quality (Bunch, 1995; David, 195; Welch, 1994). The current study suggested, however, that the psychological impact of singing on children may have been the underlying reason for their vocal health being better in their singing behaviour than in their speaking behaviour. The study indicated that the better a child's psychological well-being is, the healthier the child's vocal output is likely to be. Thus, since singing possess a facilitative effect on the children's psychological well-being and is further reflected in the children's vocal output, the psychological effect of singing may be essential in highlighting the minimal difference recorded in voice quality between speaking and singing behaviours.

10.4.3.6 A network of psychological factors

As the above discussion indicates, a number of psychological factors are connected to children's vocal products in their speaking and singing behaviours. The recorded network of psychological factors consisted of: behavioural and learning patterns; vocal identity; personality characteristics; biography; and subjective feelings of psychological well-being. The interaction between the above factors may be simultaneous, with each factor influencing the others through a variety of routes. Alternatively, it may be that the factors interact in chain-like manner, with one factor impacting another factors that subsequently influences a third factor. From the current study, the exact interaction between the factors does not become evident, however.

Singing appeared to possess a positive influence on this network of factors, particularly when a child was familiar and comfortable with singing activities. In addition, when a child had been engaged in singing more extensively, the child's psychological well-being and psychological functions were more likely to be enhanced. Therefore, it is suggested that singing engagement can potentially be exploited as a tool to enhance children's psychological well-being and functioning, subsequently being reflected in enhanced vocal health.

220

It should be noted that the findings for the psychological perspective are indicative. A systematic and more comprehensive study needs to be conducted in order to investigate the connections between the factors, as well as the influence of singing on this network of factors (see Chapter 11). Subsequently, maximum benefit can be gained from such connections in education and therapy.

10.4.4 Connections between different sociological factors

Since humans are social-beings, sociological factors have been claimed to play a significant role in shaping our behaviours (Cross, 2002; Rinta and Welch, 2008a; Welch, 2005). In relation to this, previous research has suggested that children's vocal output in their speaking and singing behaviours are simultaneously shaped by a variety of sociological factors (Barlow and Howard, 2002; Bolfan-Stosic et al., 1998; Fletcher and Hall, 1992; Nienkerke-Springer et al., 2003). More specifically, norms for appropriate voice use operate in each culture and shape children's vocal behaviours (Cross, op.cit.; Rinta and Welch, 2008a; Welch, op.cit.). For instance, stimulation received at home and in educational settings is crucial in facilitating healthy, appropriate vocal development (Mang, 2001; Moog, 1968; Nienkerke-Springer et al., op.cit.).

The findings from the current study supported the above claims that sociological factors are connected to children's speaking and singing behaviours. The findings suggested that children's vocal output in the two vocal behaviours was associated with: a) the order of siblings in the child's family; b) number of siblings in the child's family; c) the sex of the child; d) the age of the child; e) the child's linguistic background; f) the child's living environment; and g) the child's leisure activities.

10.4.4.1 Siblings

Children's family system has been found to shape children's vocal health in their speaking and singing behaviours (Fox et al., 2002; Fredman and Centeno, 2006; Green, 1998; Marshall et al., 2006; Papousek, 1996; Welch, 2005). In particular, stimulation received from one's family in daily communication has been found to play a crucial role in shaping children's speaking behaviour (Fox et al., op.cit.; Hunt and Slater, 2003). For example, siblings have been found to pre-dispose children to vocal distortions, primarily due to the fact that children are likely to abuse their voices when playing with their siblings (McAllister, 1997; Sederholm, 1996). In addition, the greater the sibling number in a child's family, the more likely the child is to abuse their voice (McAllister, op.cit.; Nienkerke-Springer et al., 2003; Sederholm, op.cit.). For instance, younger siblings are more likely to exhibited distorted vocal output, possibly due to their need to increase their vocal volume when talking in order to be heard over their older siblings (Sederholm, 1996). Furthermore, children may adopt inefficient voice production techniques from their siblings, subsequently deteriorating their vocal health (McAllister, 1997; Nienkerke-Springer et al., op.cit.).

The current study provided only minimal support for the connections between sibling factors and children's vocal behaviours, however. The sibling number and sibling-order in a child's family were connected to the child's vocal health only for a subset of the children. Thus, siblings may be a pre-disposing factor for vocal distortions, but an additional factor (such as general psychological well-being) is needed for facilitating its connection with children's vocal health. Therefore, it seems that a variety of factors (including sibling-factors) interact and are simultaneously connected to children's vocal behaviours. It may be that other factors (such as children's voice production technique) are influenced by sibling factors, further being reflected in the children's vocal output. Alternatively, it may be that sibling factors shape the other factors that, subsequently, shape children's vocal health. For instance, the general environment at a child's home may shape the child's interaction with their siblings, subsequently shaping the child's voice quality. Such interaction is likely to take place through a variety of routes.

10.4.4.2 Sex

Boys have been found to use their voices differently from girls in terms of their speaking (McAllister, 1997; Rauhala, 1991; Sederholm, 1996; Virokannas, 1997). Boys have been found to be more likely to abuse their voices, consequnetly the prevalence of voice distortions being higher amongst boys than amongst girls (McAllister, op.cit.; Sederholm, op.cit.). In terms of singing behaviour, boys are less likely to engage in singing activities (Welch, 1998). Such a lack of singing engagement is likely to result in poor vocal awareness, further being reflected in the boys' vocal products.

222

However, the current study suggested that the connections between sex and children's vocal behaviour varies. No clear and straightforward relationships between the children's sex and their vocal health were recorded. It may be that children's living environments facilitate the effect of sex on children's vocal output. For instance, home environment ma encourage specific vocal behaviours in boys, further being reflected in their vocal health. Local living environment, rather than wider cultural, factors appeared to be of more importance in shaping children's vocal health. Evidence for this was found from the fact that the two groups that demonstrated a connection between children's sex and their vocal products were located in different countries, indicating that there were not strong cultural trends as to these connections.

Furthermore, the current study indicated that boys and girls were equally susceptible to vocal distortions. It may be that the children's personality characteristics and leisure-time activities, as well as stimulation from their immediate environment, formed significant connections with the children's vocal health. Consequently, sex-differences may manifest on the basis of ideas on appropriate voice use that are dependent on the education that the child has received whilst growing up (Bolfan-Stosic et al., 2003; Mang, 2001; Welch, 1985; 1998). For instance, concepts that teachers and parents hold on the activities perceived as appropriate and acceptable for girls to engage in may encourage girls' to produce their voices in particular ways (Cross, 2002). When girls are encouraged to engage in outdoor activities, they are more likely to exhibit vocal distortions in comparison to girls from cultures encouraging solitary activities (McAllister, 1997; Sederholm, 1996). Such differences in perception and in local practice may have contributed to the contradictory results recorded in this study(see Appendix 2).

It should be noted that, in Western culture, the traditional idea on appropriate activities for girls to engage in are undergoing change. Therefore, greater cultural difference in terms of the activities that girls are allowed to engage in may be recorded nowadays, further being reflected in the recorded differences in children's vocal health. For instance, it may be that girls in the UK are more actively engaged in outdoor hobbies and sports during their break-times at school than the girls in Finland were, manifested in the recorded unhealthier voice quality in a subset of the English girls.

223

Furthermore, it should be noted that there were differences as to the cultural origins of the girls and the boys who exhibited poorer vocal health. The boys were primarily of Arabic and Somali origin, whilst the girls were primarily of Jamaican or British origin. It may be that cultural factors (such as linguistic factors or perceptions of appropriate leisure time activities) facilitated the recorded differences. It may be that these girls had all adopted similar voice production techniques. It may also be that, in particular cultures (such as in the UK), girls do not sing as much as girls do in other cultures (such as in Finland), potentially being reflected in the girls' vocal output. In addition, children's religious background may have inhibited the children from engaging in singing and other musical activities (Salameh, 2006). For example, Muslim children may not have been engaged in singing, being reflected in their vocal output.

Moreover, it may be that boys and girls are educated to use their voices differently, according to the norms operating in their local culture (Bolfan-Stosic et al., 2003; Nienkerke-Springer et al., 2003). For instance, when boys are encouraged to adopt a masculine role, they may modify their voice production technique so that their final vocal products fulfil the desired voice quality regarded as masculine (such as rough voice quality that is associated with a 'tough man image') (Nienkerke-Springer et al., op.cit.; Welch, 2005). Similarly, the female role may be emphasised to girls, with girls consequently adopting gentler voice production techniques (such as speaking in an unnaturally high pitch) (Bolfan-Stosic et al., op.cit.). In addition, different singing styles require different voice production techniques in order to achieve an acceptable voice quality for each style (Sundberg, 2001).

The above discussion, therefore, provided support for previous studies that advocated the connections between cultural factors and children's vocal behaviours (McAllister, 1997; Rauhala, 1991; Sederholm, 1996; Virokannas, 1997). The discussion indicates that, despite the fact that sex may at times form a significant relationship with children's vocal output, an additional factor (such as children's personality characteristics) is needed in order for facilitate such connections. A network of factors (including internal and external factors, as indicated in Sections 10.2 to 10.5) is connected to children's vocal behaviours and the inter-action between different components of the factors varies from child to child, further being reflected in their vocal output.

224

10.4.4.3 Age

Children's voice quality is likely to be connected to their age (Andrews, 199197; Sederholm, 1996; Welch, 1994; 1998; White, 2001). The physiological changes taking place whilst children grow up are likely to affect the physical mechanisms that underlie children's vocal behaviours, further being reflected in the children's voice production (Andrews, op.cit.; Hunt and Slater, 2003; Mathieson and Greene, 2003; Welch, op.cit.). It is likely that children who approach pubertal age exhibit different voice quality from their younger peers. However, comparative studies across different age-groups have not been carried out and, therefore, it is not known whether voice quality differs from one age-group to another.

The current study indicated that age does not necessarily form significant relationships with children's vocal health in their speaking and singing behaviours. At times, age formed a significant relationship with children's voice quality in their singing behaviour. Significant differences in voice quality were only recorded when the age-gap was wider than two years (see Section 10.4.3.4). Older children exhibited unhealthier voice quality than their younger peers in their speaking behaviour, but healthier voice quality in singing than their younger peers. It is likely that older children had undergone a greater amount of formal singing training and, therefore such training had had a facilitative effect on their voice quality. It may also be that singing training had raised the children's awareness of appropriate voice use, subsequently facilitating healthy voice quality. Furthermore, older children were likely to be familiar with singing activities, which was reflected in their vocal output in their singing behaviour.

10.4.4.4 Linguistic background

Mother-tongue and children's vocal behaviours have been connected to one another (Altenberg and Ferrand, 2006; Bolfan-Stosic et al., 2003; Klein et al., 2006b; Mang, 2001; Papousek, 1996; Rethfeldt and Miller, 2006; Van Bezoojien, 1995). The characteristic sounds of different languages shape children's phonation ability and their skills needed for speaking (Papousek, op.cit.; Van Bezoojien, op.cit.). Such characteristics sounds are inevitably reflected in the children's final vocal products (Mang, op.cit.; Papousek, op.cit.). The current study supported such claims. Considerable differences were recorded between children speaking different mother-tongues. For instance, native Somali- and Arabic-speakers were more likely to exhibited unhealthier vocal output than native English- and Finnish-speakers (see Chapter 9).

The phonation and voice production techniques required for the generation of different languages may have significantly contributed to children's voice production process (Salameh, 2006). It may be that a greater deal of strain is placed on the voice mechanism when speaking in specific languages (such as Arabic) due to the vocal sounds that the language consists of. For example, strong /s/ or /r/-sounds that are prominent in Arabic may possess a deteriorating effect on Arabic children's voices. It may also be that children of different cultural origins may be educated to produce specific vocal sounds in order for their voice quality to fulfil the cultural concepts of 'normal' voice quality (Mang, 2001).

Furthermore, culturally-located perceptions of 'normality' may educate children in considering 'abnormal' voice qualities as 'normal' (Mathieson and Greene, 2003; Mang, 2001). For instance, children may have learnt to perceive hoarse vocal sound as 'normal' (McAllister, 1997; Sederholm, 1996). In addition, children may learn to produce their voices with excessive force when attempting to fulfil such cultural norms of 'normal' voice quality, resulting in hyperfunctional voice production process and being reflected in voice quality.

Moreover, the current study supported the previous claims that the vocal health of bi-linguals differs from mono-linguals (Salameh, 2006). For example, children who spoke African or Arabic languages as their mother-tongues and English as their additional language exhibited distinctively hoarse and rough voice quality (see Chapter 9). Moreover, native English- and Finnish-speakers generally exhibited healthier voice quality in their speaking and singing behaviours than their non-native peers did. The recorded differences may have manifested due to excessive pressure placed on the voice mechanism when speaking in an additional language (Altenberg and Ferrand, 2006; Klein et al., 2006b; Rethfeldt and Miller, 2006). Furthermore, the vocal sounds that the children's additional language consisted of may have been distinctively different from those of the children's first language, subsequently shaping the children's vocal output and further resulting in unhealthier voice quality. A further explanation for the recorded

226

differences between mono- and bi-linguals is that bi-linguals may not have been exposed to as great an amount of feedback in relation to their additional language as they had in relation to their mother-tongue. For example, bi-linguals may not have received substantial feedback for monitoring their voice production techniques. Additionally, they may not have been provided with appropriate voice models when learning their additional language.

It should be noted, however, that the linguistic differences recorded in the current study may not have been as distinct as indicated, had the judges performing the perceptual voice assessment been of different cultural origins (such as from African countries or from the Middle East). Moreover, the vocal output of children from specific backgrounds (such as of Arabic origin) may not have been perceived as unhealthy by judges from Arabic origin. Therefore, the cultural indications presented here are only tentative and need to be exposed to further research (see Chapter 11).

10.4.4.5 Environmental factors

Daily living environment has been argued to play a crucial role in shaping children's vocal health (Carding et al., 2006; Deliyski et al., 2005; Hunt and Slater, 2003; Morton and Watson, 2001; Sederholm, 1996; Speciale and Cimino, 2000; Sodersten et al., 2005; Ternstrom et al., 2005; Virokannas, 1997). An appropriately stimulating environment at home and at school has been regarded as of prime importance in facilitating healthy vocal development (Morton and Watson, op.cit.; Welch, 1994; 2005). Moreover, appropriate role-models on appropriate voice production are essential in order for children to produce their voice in a healthy way (Morton and Watson, 2001; Welch, op.cit.).

In support of the above claims, the current study suggested that the participant children's daily living environment contributed to their vocal health in their speaking and singing behaviours, as evidenced in differences recorded between the four small groups of children. The difference was evident in the fact that the children in the UK possessed a tendency to exhibited slightly different voice quality from the children in Finland (see Section 10.2). The fact that the living environment in Finland was more rural than the living environment in the UK may have facilitated the recorded differences. For instance,

227

a greater amount of air-pollution is likely to be found in urban environments, with pollution potentially posing a deteriorating effect on the children's vocal health (McAllister, 1997; Sederholm, 1996). In addition, a greater deal of environmental noise is likely to recorded in urban than in rural settings, potentially placing excess pressure on the physiological mechanisms used for voice production. It may also be that linguistic factors in combination with local environment facilitated such recorded differences.

Furthermore, the acoustic environment of the participating schools may have been a contributing factor due to additional demand placed on the voice production process in poor acoustic environment (Nienkerke-Springer et al., 2003; Sedeholm, 1996; Ternstrom et al., 2005). Such poor environment is likely to pose a deteriorating effect on the final vocal products unless children know how to project their voices appropriately (Ternstrom et al., op.cit.). However, such acoustic differences were not exposed to systematic investigation in the current study and the suggestions provided here are only indicative. A systematic study needs to be conducted in order to investigate the above indicative findings further (see Chapter 11).

10.4.4.6 Leisure activities

In previous studies, connections between leisure activities and children's vocal health have been recorded (Barlow and Howard, 2002; Bolfan-Stosic et al., 1998; Fletcher and Hall, 1992; Nienkerke-Springer et al., 2003). Active hobbies and outdoor activities (such as sports) have been found to pre-dispose children to voice abuse and, subsequently, to pose a deteriorating effect on children's vocal health (Bolfan-Stosic et al., 2003; Mathieson and Greene, 2003). Leisure activities have, in turn, been found to be connected to children's personality factors (see Section 10.4.3.2). For example, when a child is perceived as hyperactive, the child is more likely to engage in active leisure time hobbies (Mathieson and Greene, op.ci.t).

Furthermore, hobbies requiring a considerable amount of voice use (such as performing art hobbies) may pre-dispose children to voice distortions unless the children are educated on appropriate voice production techniques (Mathieson and Greene, 2003; Rinta, 2008; Williams et al., 2005). Extensive singing training may also pose a deteriorating effect on children's voice quality (Williams et al., op.cit.). The findings from the current study supported such claims since leisure activities and personality factors in combination appeared to possess a deteriorating effect on the child's vocal output. Alternatively, it may be that poorer vocal health had a deteriorating effect on the children's personality development and influenced their choice of leisure-time activities. It may be that children with unhealthier voice quality are more likely to engage in active leisure time hobbies. It may also be that there is a third factor (such as psychological well-being) simultaneously influences the child's vocal output and the child's choice of leisure activities. Nevertheless, a network consisting of personality factors, leisure time activities and vocal health appears to be in operation.

10.4.4.7 Summary for sociological factors

The above discussion indicates that a variety of sociological factors are connected to children's vocal health in their speaking and singing behaviours. Local culture and living environment appeared to form strong connections with children's vocal functioning and voice quality. Sociological factors play a part in a complex network, in which a variety of factors from a variety of origins are simultaneously connected to children's vocal health in their speaking and singing behaviours. In such a network, a variety of factors (such as those of psychological and physiological origins) interacts and are connected to children's vocal functioning and voice quality in the two vocal behaviours.

10.5 Vocal developmental aspects of children's speaking and singing behaviours

Children's vocal development in their speaking and singing behaviours has been of interest to professionals working in educational and therapeutic fields. Activities and tasks implemented in educational and therapeutic settings often focus on developing children's speaking and singing competencies in an attempt to enhance children's final vocal products (Hunt and Slater, 2003; Mathieson and Greene, 2003; Welch, 1994). Therefore, teachers' and therapists' primary interest has been on facilitating appropriate vocal development in terms of raising their competency levels by providing children with a nurturing environment and appropriate instruction on how to produce their voices (Mang, 2001; Welch, 1998).

In fact, children's vocal development is often measured through assessing a child's competency in that particular vocal behaviour (Hunt and Slater, 2003). This type of assessment has been adopted to use in order to have asses children's vocal development in a concrete way (Welch, 1998). It has been believed that competency in either vocal behaviour can be developed in educational and therapeutic settings, subsequently leading to enhanced vocal products (Andrews, 1991; Hunt and Slater, op.cit.). For example, a higher level of singing competency is likely to be reflected in healthy vocal products in singing (Williams et al., 2005).

10.5.1 Perceived level of speaking and singing competency

The perceived level of a child's speaking and singing competencies represent the child's refined skill in the vocal behaviour (Addo, 1998; Ball, 1991; Koivusaari, 1998; Mang, 2001). As mentioned above, competency in either vocal behaviour can be assessed on formal protocols that consist of pre-set criteria for different levels of competency (Mang, op.cit.; Morton and Watson, 2001; Welch, 1994). Such competency measurement can be compared to reading assessment, for instance, in which the level of a child's reading ability is assessed against pre-set criteria (Koivusaari, op.cit.). More specifically, there are distinct differences between the skills needed for generating speaking behaviour and those required for generating singing behaviour (Bunch, 1997; David, 1995; Mathieson, 2000; Rubin et al., 2003). For example, in singing, a child is required to shift the balance of tension from one vocal pitch to another with a higher speed than in speaking (David, op.cit.). The different natures of the two vocal behaviours are likely to shape the voice production techniques required for each vocal behaviour, being reflected in the final vocal output (Laukkanen et al., 2005; Reid, 2001; Rubin, 2006; Williams et al., 2005).

Nevertheless, speaking competency is closely linked to cognitive abilities that are relied on in any linguistic activity (Morton and Watson, 2001). For instance, the ability to formulate comprehensible sentence structures is inevitably connected to one's ability to speak (Eisenson and Ogilvie, 1977). Thus, speaking competency is likely to rely on a variety of cognitive abilities that are not necessarily connected to vocal functioning per se. Similarly, singing competency relies on a variety of cognitive functions (such as the ability to match own vocal pitch with a musical tone) (Mang, 2001; Williams et al., 2005). Such claims imply that the perceived level of a child's competency in one vocal behaviour is not necessarily the primary factor shaping the child's final vocal output.

In fact, the current study suggests that the perceived level of competency in either vocal behaviour did not form a significant connection with the children's vocal functioning and voice quality. Moreover, for a subset of the children, a higher level of speaking and singing competency was connected to unhealthier vocal output (see Appendix 2). It may be that these particular children had undergone a greater amount of singing training, consequently using their voices more extensively and resulting in unhealthier vocal output. Alternatively, it may be that these particular children's vocal functioning was more refined in their singing behaviour, with their refined skills highlighting distinct vocal characteristics and potentially biasing a listener's perception of the vocal output toward unhealthy quality. It may also be that ineffective singing teaching methods may have had a deteriorating effect on the children's competency level and, subsequently, on their final vocal products.

Although the findings indicated that perceived competency in either of the two vocal behaviours is not of prime importance, significant relationships were recorded between the competency levels in both vocal behaviours and specific voice parameters (see Chapter 7). The individual voice parameters connected to the vocal competencies varied from one to the other. From this study, explanations for the significant relationships do not become evident. It may be that the different natures of the two vocal behaviours, as well as the refined skills needed for facilitating each vocal behaviour, may be reflected in the final vocal products. It may also be that a greater amount of voice use in either vocal behaviour (such as in singing) may resulted in vocal fatigue, further being reflected in unhealthier quality in specific voice parameters that were more sensitive to such fatigue than other voice parameters (Fuchs et al., 2007; Williams et al., 2005).

The current study suggests that, rather than the perceived level of children's speaking and singing competency forming significant connection with children's final vocal products, a variety of physiological, psychological and sociological factors are connected to their vocal health in both vocal behaviours (Baker, 2002a; b; Bunning, 2004; Brown et al.,

231

2004; Costa-Giomi, 2002; Hunt and Slater, 2003; Mathieson and Greene, 2003; McAllister, 1997; Sederholm, 1996; Thurman and Welch, 2000). It may be that holistic factors are also related to the perceived level of competency in either or both vocal behaviours. It may be, then, that holistic factors form connections with children's perceived levels of competency and their final vocal products independently (see Figure 10.1).

Despite the above discussion that indicated that the perceived level of competency in speaking or singing behaviour was not necessarily connected to children's vocal output, perceived level of competency is a factor that needs to be considered in therapy and education since it is connected to children's ability to speak and sing, as indicated above. In particular, when treating child clients with speech disorders, it is essential to consider their competency in their speaking behaviours. A further study is needed, however, for investigating the relationships between holistic factors, perceived level of speaking and singing competency and children's vocal health (see Chapter 11).

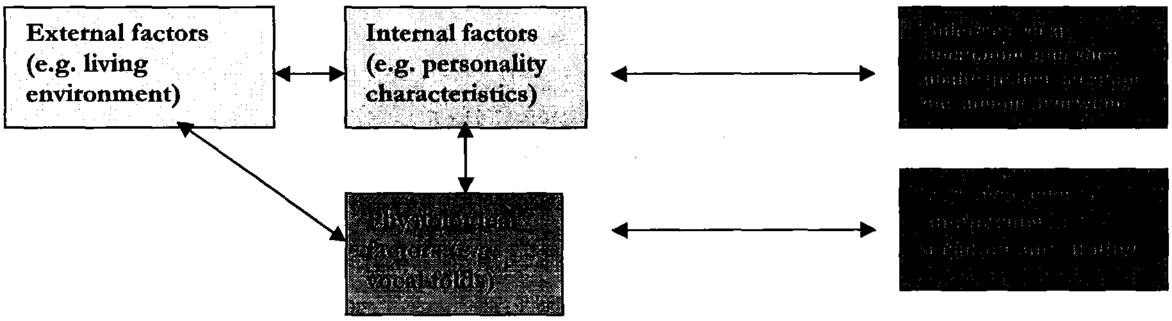


Figure 10.1: Influence of external and internal factors on children's vocal health in their speaking and singing behaviours, as well as the perceived level of competency in either vocal behaviour

10.6 Inclusion of singing and consideration of holistic factors in perceptual voice assessment with pre-pubertal children

In Chapter Four, the potential inclusion of singing and holistic factors in perceptual assessment with pre-pubertal children was discussed theoretically. Perceptual voice assessment with the use of a specially-designed perceptual voice assessment protocol that took speaking and singing behaviours into consideration was adopted to the current study (see Chapter 5; see Appendix 1 for the protocol).

In this section, the inclusion of singing and holistic factors in perceptual voice assessment with pre-pubertal children is discussed by integrating the empirical indications from the current study to the literature. The reliability and validity of the specially-designed perceptual voice assessment protocol used in the study is discussed. First, the benefits from including singing in such assessment are provided. Secondly, the role of holistic factors in voice assessment is discussed. Thirdly, the function of the new perceptual voice assessment protocol is considered.

10.6.1 Benefits from including singing in perceptual voice assessment with pre-pubertal children

As discussed in Chapter 3, speech and voice therapists have traditionally focussed on children's speaking behaviour in perceptual voice assessment (Bores, 1984; Sederholm, 1996). Singing behaviour has not been considered as extensively due to the fact that children spend a greater deal of their time speaking than singing (Sederholm and McAllister, 1997). Moreover, speaking behaviour has been of primary importance since it is our main form of communication in daily situations (Andrews, 1991; Mathieson and Greene, 2003).

Nevertheless, considering children's singing behaviour in voice assessment could potentially be beneficial since it may be that the children's voice production technique in their singing behaviour is causing their voice to become distorted (Rubin et al., 2003; Wilson, 1987). For instance, when a child has not been educated in producing their voice properly when singing, excessive strain may be placed on the voice mechanism and,

233

subsequently, the child's final vocal output is affected (Bunch, 1997). In particular, when children are not singing in appropriate voice register, they may strain their voices when singing and their voice quality may deteriorate (Williams et al., 2005). Singing may also highlight aspects of physiological malfunctioning that are not recorded in speaking behaviour due to the functional differences between the two vocal behaviours (Bunch, op.cit.; Mathieson, 2000). The current study supported these claims by indicating that singing can be a useful complimentary tool for perceptual voice assessment with children from a variety of perspectives.

More specifically, the current study indicated that, through considering both speaking and singing behaviours, a comprehensive profile for the child's vocal functioning and voice quality can be formulated (Carding et al., 2000; Kreiman and Gerratt, 2000; Yamaguchi et al., 2003). Perceptual voice assessment considering both vocal behaviours was found to be a beneficial starting-point for a thorough voice assessment process (Hunt and Slater, 2003; Mathieson and Greene, 2003). Such a perceptual voice assessment process can highlight initial elements of vocal dysfunction and formulate a starting-point for subsequent assessment indicating any initial vocal pathologies (Rinta, 2005).

Furthermore, the traditional assumption in speech and voice therapy practice has been that speaking and singing behaviours generate different types of voice data, on the basis of the traditional idea that children possess 'a speaking voice' used for generating speaking behaviour and 'a singing voice' used for singing behaviour (Rinta and Welch, 2008b). Nevertheless, the current study indicated that children's vocal functioning and voice quality are similar in both vocal behaviours. Therefore, the findings indicate that the assessment outcome derived from speaking behaviour does not significantly differ from the assessment outcome derived from singing behaviour, further indicating that considering both vocal behaviours in perceptual voice assessment does not bias the assessment outcome. Rather, the functional differences recorded between the two vocal behaviours can be benefited from in perceptual voice assessment.

Moreover, speaking tasks have primarily been relied on in voice assessment (Andrews, 1991; Hunt and Slater, 2003; Mathieson and Greene, 2003; Rinta, 2005; White, 2001). Simple reading and speaking tasks have primarily been sources of voice data (Hunt and

Slater, op.cit.). Minimal evidence for including simple songs and pitch-glides in formulating a reliable vocal profile for children has been gathered (Aitman et al., 2004; Mang, 2001; Tanner et al., 2004; Welch, 1985; White, 1997). However, such tasks are not always adopted to practice primarily due to a lack of knowledge on the benefits of including such tasks in perceptual assessment (Rinta, op.cit.). The current study, nevertheless, indicated that pitch-glides and simple songs were found to be reliable tools in gathering complimentary voice data to the data gathered through speaking tasks. Since pitch-glides and simple songs are relatively easy tools to be used, therapists do not necessarily need to undergo special musical training and they do to need to be trained singers in order to implement such tasks on their practice. For example, therapists can use simple songs from primary school music books in their practice.

Benefits for including singing in perceptual voice assessment with children from the physiological and psychological perspectives were recorded. From the physiological perspective, the current suggested that physiological malfunctioning behind a speech or voice distortion could be detected through singing. Specific aspects on the children's voice production process and specific vocal elements could be identified through focussing on the children's singing behaviour and through comparing the outcome from assessing the children's speaking behaviour and to the outcome from their singing behaviour (Rinta and Welch, 2008a). For example, singing was found to be a useful tool for highlighting 'abnormal' functioning in the children's breathing patterns, as evidenced in voice-breaks and unstable pitch being identified more easily through focussing in the children's singing than in their speaking.

From the psychological perspective, the main benefit of including singing in perceptual voice assessment with children was its perceived relaxing effect on children (Bonet and Cason, 1993; Clift and Hancox, 2001; Cross, 2002; Milutinovic, 1994; Welch, 2001). Singing was recorded to possess a relaxing influence on children through counter-acting the potential negative effect of the assessment situation, subsequently reflected in the children's vocal output, as evidenced in their overall voice quality and the quality of specific voice parameters (Baker, 2002a; b; Carding et al., 1999; Coster et al., 1999; Fox et al., 2002; French, 2006; Heitmann, 2004; Hielscher, 2004; Sederholm and McAllister, 2001; Van Borsel et al., 1999; Weber-Fox, 2001). More specifically, children may feel tense in the assessment situation, potentially further interfering with their vocal output

235

(Andrews, 1991). Singing could potentially used as a means to relax the children in the assessment setting, consequently resulting in a more reliable assessment outcome. Such states of relaxation may also have been the underlying reasons for the majority of the participant children in the current study exhibiting healthier voice quality in their singing behaviour than in their speaking behaviour.

10.6.2 Benefits from considering holistic factors in voice assessment with pre-pubertal children

One of the major challenges faced by professionals in perceptual voice assessment with pre-pubertal children is the process of identifying potential underlying causal and contributing factors for children's speech and voice distortion (Blumental, 2006; Carding et al., 2000; Mathieson and Greene, 2003; Thurman and Welch, 2001; Wilson, 1987; Yamaguchi et al., 2003) (see Chapter 4). Since such distortions may derive from a variety of factors as indicated in Section 10.4, a comprehensive assessment process needs to be undertaken in order to identify any significant causal factors behind the distortions (Hayasaka, 1995; Hunt and Slater, 2003). For example, a thorough medical examination and a psychological test could be administered in order to address the underlying causal factors (Mathieson and Greene, op.cit.).

The process of assessing for a variety of potential causal and contributing factors is time-consuming and, therefore, often undermined in professional practice (Rinta, 2005). Instruments that are straight-forward to use can be adopted to professional practice when assessing for such possible underlying causal and contributing factors. The instruments exploited in the current study were regarded reliable and valid tools for such assessment. They were also found to be less time-consuming and simple to use. The instruments are also easily adaptable and, therefore, can also easily be adjusted to cater for individual clients. The instruments could, therefore, be used in the initial stage of voice assessment and be supplemented with additional assessment methods when necessary.

The professional can choose to rely on specific instruments more than on others according to the causal factors that appear to be most dominant. Similarly, the instruments can be modified to cater for children of different cultural origins. The instruments can be used as the main ones in assessing for underlying causal and

236

contributing factors and additional assessment instruments can be adopted to use when regarded necessary. Moreover, it should be noted that specific physiological mechanisms were not investigated in the current study since such assessment would require special medical knowledge and equipment that were not accessible for the researcher. Thus, data for potential underlying physiological correlates was only derived from the voice-scientific perspective (see Chapter 6).

In addition to gathering data from children themselves with the use of the indicated instruments, interviews or questionnaires could be administered to children's parents or carers, as well as to their teachers, in order to gather less subjective data on the potential underlying factors and to verify and clarify information derived from the children. For example, a personality inventory could be filled in by a therapist or a psychologist in order to gather less subjective data on potential psychological causal and contributing factors.

It should be noted that professional speech and voice therapists need to be educated in considering all potential underlying causal and contributing factors in their therapy sessions and when assessing their clients. Rather than having to employ a team of professionals (such as an ear, throat and nose specialist for assessing any physiological causal factors and a psychologist for assessing any psychological factors), therapists can be educated in carrying out the assessment tasks that address a variety of causal and contributing factors on their own.

10.6.3 Benefits of the specially-designed perceptual voice assessment protocol with pre-pubertal children

Perceptual voice assessment is one of the main tools exploited in professional speech and voice therapy practice (Carding et al., 2000; Hunt and Slater, 2003; Kreiman and Gerratt, 2000). Such voice assessment forms the basis for subsequent voice assessment and illustrates initial distortions in children's vocal behaviours and output primarily with regard to children's speaking behaviour (Carding et al., op.cit.; Marshall et al., 2006; Yamaguchi et al., 2003). Perceptual voice assessment has been regarded a convenient and efficient assessment tool since it relies on the professionals' listening skills rather than external technology (see Chapter 4). On the basis of such arguments, perceptual voice assessment was adopted as the main assessment tool for the current study.

Formally-established perceptual voice assessment protocols have focussed on children's speaking behaviour (Carding et al., 2000; Hirano, 1989; Mathieson and Greene, 2003; Yamaguchi et al., 2003), whilst singing assessment protocols have focussed on assessing singing competency (Mang, 2001; Welch, 1994; White, 1991). Therefore, for addressing the aims of the current study, a new perceptual voice assessment protocol was formulated (see Chapter Five and Appendix 1). The new protocol was needed for comparing vocal output from children's speaking behaviour to that from their singing behaviour (Carding et al., op.cit.). The protocol was found to fulfil its function efficiently through considering both general voice quality and specific voice parameters when comparing the two vocal behaviours. The study indicated that the protocol was a reliable and valid instrument to be used for assessing pre-pubertal children's vocal functioning and voice quality in their speaking and singing behaviours. The comprehensive instructions provided as to how to use the protocol and the list of definitions for the individual voice parameters included in the protocol were found to increase the reliability of the protocol.

More specifically, several potential reasons for the protocol having been found to be a reliable assessment tool were recorded. The primary recorded reasons were: a) the protocol was well-designed on the basis of existing perceptual voice assessment protocols and singing competency assessment protocols; b) the protocol consisted of identical sections for speaking and singing behaviours for comparative purposes; c) the protocol was modified subsequent to the pilot study in order for it to contain necessary and beneficial voice parameters and vocal elements; d) the judges were provided with detailed instructions as to how to use the protocol prior to conducting the assessment task; e) the protocol was supplemented with definitions for each specific voice parameter and with a CD demonstrating different voice qualities; and f) the protocol consisted of continuous lines that were 7 cm-long and that could be divided into seven 1 cm-long sections enabling judges to perform their assessment without restricting scaling-points (See Chapters Four and Five for a more detailed discussion on the protocol; see Appendix 1 for the protocol).

238

Moreover, all of the judges agreed on the reliability and validity of the protocol, with the inter-judge reliability for the protocol being high. Nevertheless, the inter-judge reliability could be investigated further with a greater number of judges from different cultural backgrounds, as well as with a greater number of voice samples. Ideally, the protocol should be supplemented with recorded voice samples when adopted to professional practice. These recoded voice samples could, then, function as a baseline for therapists in order for them to able to compare their child clients' voices for obtaining objective, relibale and accurate voice outcomes from the assessment process. The voice samples could also contain examples of 'normal' and healthy, as well as 'abnormal' and unhealthy, vocal functioning and voice quality for both speaking and singing behaviours and for a comprehensive set of voice parameters. Such practice would ease the process of differentiating between 'normal' and 'abnormal' vocal functioning and voice quality.

Perceptual voice assessment has been criticised for its subjective nature that has been agreed to be extremely reliant on the person carrying out the assessment (Anders et al., 1988; Carding et al., 2000; Kreiman and Gerratt, 1998; 2000; Kreiman et al., 1992; Lewison and Carding, 2003; Lindsay et al., 2002; McCrory, 2001; McFarlane et al., 1991; Shrivaskov and Sapienza, 2003; Zraick et al., 2004). Nevertheless, the new perceptual voice assessment protocol was found to be a reliable and valid instrument for assessing children's vocal health in their speaking and singing behaviours (see Chapter 5). This specially-designed protocol gathered voice data reliably for both vocal behaviours. The protocol was found to cover children's essential vocal characteristics and to consider a comprehensive set of voice parameters. The vocal elements that the protocol consisted of assisted in formulating a comprehensive vocal profile for each child. Although the protocol was found to fulfil its function effectively and comprehensively, a greater number of independent voice parameters could potentially be included in the protocol (see Section10.7.3; see Chapter 11). Since the protocol contained a section for additional vocal characteristics, this section could also be used for recording any additional details on the children's vocal functioning and voice quality.

Since speech and voice therapists are not, in general, educated in including singing in their practice in their voice assessment or in their therapy sessions (Carding et al., 2000; Behman, 2004), therapists may not be used to listening to children's singing behaviour and they are not necessarily used to detecting vocal distortions in their singing behaviour. Such claims indicate that, prior to encouraging professionals to include singing in the assessment process and in their therapy sessions, it is essential to educate professionals in such practice. Once professionals have been familiarised with singing behaviour during their training and they have become aware of the benefits of including singing in their practice, they are more likely to be feel confident as to including singing in their therapy sessions, as well as when assessing children's vocal functioning and voice quality.

As mentioned earlier, ideally, the protocol should be supplemented with examples for individual voice parameters, as well as for 'normal' and 'abnormal' vocal characteristics, in regard to speaking and singing behaviours. However, collecting a comprehensive set of voice samples is a challenging tasks, with considerable ethical and time-constraints needing to be addressed (see Chapter 11) Therefore, the new protocol can be adopted to professional speech and voice therapy practice, based on the findings from the current study. Nevertheless, the protocol should, at all times, be accompanied with a comprehensive set of instructions and an exclusive list of definitions for individual voice parameters and vocal elements, similarly to the current study. Once professionals are administered with such comprehensive sets of instructions and examples of voice data, the outcomes from their perceptual voice assessment with child clients are likely to be reliable.

10.7 Summary

In summary, specific implication for research and practice arise from the above discussion. Suggestions for education and therapeutic practice can be outlined as follows:

a) The 'normality' and 'abnormality' of children's vocal functioning and voice quality in speaking and singing behaviours are culturally-located.

b) Children posses one voice that is used for generating their speaking and singing behaviours, rather than 'a speaking voice' for generating speaking behaviour and 'a singing voice' for generating singing behaviour.

c) There are indications as to children relying on the same physiological mechanisms in generating their speaking behaviour as they do in generating their singing behaviour.

d) Psychological factors seem to be connected to children's vocal functioning and voice quality with reference to their speaking and singing behaviours.

e) Sociological factors (both local and global) seem to be connected to children's vocal functioning and voice quality in their speaking and singing behaviours.

f) Children's speaking and singing behaviours seem to be connected through physiological, psychological, sociological and voice-scientific perspectives.

g) The perceived level of competency in either vocal behaviour is not directly connected to the children's vocal health in their speaking and singing behaviours.

h) Overall vocal development that is influenced by a variety of holistic factors appears to be an essential element in facilitating healthy vocal functioning and voice quality in children's speaking and singing behaviours.

i) The specially-designed perceptual voice assessment protocol was found to be a useful, reliable and effective tool to be adopted to perceptual voice assessment.

The above discussion provides suggestions for educational and therapeutic practice, as well as for further research. Such implications are further discussed in Chapter 11.

241

Chapter 11: Implications for education, therapeutic practice and for further research – conclusion for the study

11.1 Introduction

In Chapter 10, the research questions proposed for the study and the empirical findings from the study were discussed in relation to the theoretical framework proposed in Chapter 3. The aim of Chapter 10 was to compare the theoretical claims from Chapters 2 and 3 to the empirical findings presented in Chapters 6-9. Through integrating the empirical findings to the theoretical framework suggestions for educational and therapeutic practice, as well as for further research, were gathered.

In this Chapter, suggestions for educational and therapeutic practice are offered. Firstly, implications for educational practice are presented. Secondly, indications for therapeutic practice are provided. Thirdly, suggestions for further research are proposed. Finally, conclusion for the study is presented.

11.2 Suggestions for educational practice

The initial focus of the study was on exploring the potential use of singing in speech and voice therapy practice. When addressing this research question, significant implications for educational practice were recorded. In this section, benefits associated with singing activities and how such benefits could potentially be exploited in educational practice are discussed.

11.2.1 Implications for a physiological perspective

The study indicated that children possess one voice that is used for generating their speaking and singing behaviours rather than 'a speaking voice' used for generating speaking behaviour and 'a singing voice' used for generating singing behaviour (Sundberg, 1996; 2001; Welch, 2005) (see Chapter 6; see Section 10.2. in Chapter 10).

243

This finding, therefore, indicates that teachers should be educated on the concept that children possess one voice and they should, subsequently, educate children on such a concept. The functional differences underlying the two vocal behaviours , as well as their distinct natures, should be demonstrated to teachers and children in order to illustrate that it is appropriate to talk about speaking and singing behaviours but not 'speaking' and 'singing voices'. The similar characteristics between the two vocal behaviours should be emphasised to teachers and children.

Educating children on the fact that the same voice is used for generating their speaking and singing behaviours could be conducted in music lessons. For example, a variety of voice exploration techniques and vocalisation exercises that slowly shift from speaking behaviour to singing behaviour could be used as a means to highlight the connections between the two vocal behaviours (Hegde, 2007; Mathieson and Greene, 2003; Montello, 2002; Rubin et al., 2003; Wilson, 1987; Welch, 2005). Such activities could also increase teachers' and children's confidence in using their voices and, subsequently, facilitate positive vocal identity development. In addition, the traditional concept that only talented individuals with 'a singing voice' are able to sing can be challenged through such a holistic approach (Welch, 1994).

Since singing engagement can facilitate healthy vocal development and vocal awareness (see Chapter 6 and 8), teachers need to adopt appropriate techniques for teaching singing (Rinta, 2008; Welch, 1994). The finding that raising the level of singing competency is not of prime importance when developing children's singing abilities should be emphasised to teachers. Rather, a greater deal of importance should be placed on facilitating confidence in voice use through a variety of vocal exercises (see Chapter 7 and 8). Singing activities can also be used as a means to educate children on vocal health through increased awareness of the physiological mechanisms underlying their speaking and singing behaviours. For example, singing activities can be used as a tool to encourage children to pay more attention to their voice production process, subsequently preventing voice abuse from manifesting (Rinta, op.cit.; Williams et al., 2005).

The physiological changes taking place in the child voice mechanisms while children grow up should be stressed to teachers in order for them to be aware of how such changes affect children's vocal output in both vocal behaviours (McAllister, 1997;

Sederholm, 1996; White, 2001). For instance, distinct perceptual differences can be recorded between 7- and 10-year-olds, primarily as a result of underlying physiological changes (see Appendices 2-5).

Furthermore, teachers and children need to be educated on perceptually 'normal' and 'abnormal' characteristics of the child voice, as well as how such characteristics vary from culture to culture (Andrews, 1991; McAllister, 1997; Sederholm, 1996; White, 2001). Subsequently, children with 'abnormal' vocal output can be referred to professional therapeutic practice prior to their exhibited distortions developing into more severe forms of disorders (Andrews, op.cit.; Hunt and Slater, 2003). Since other difficulties (such as behavioural or learning difficulties) are connected to speech and voice disorders, early diagnosis of all vocal distortions may prevent psychological difficulties from manifesting. Provided that teachers were educated to carry out perceptual voice assessment, they would be able to diagnose initial speech or voice distortions in their pupils.

11.2.2 Implications for a psychological perspective

As mentioned in Chapters 2 and 3, physiological and psychological factors are closely connected to children's vocal behaviours (Baker, 2002a; b; Hunt and Slater, 2003; Mathieson and Greene, 2003; Rinta, 2008; Rinta and Welch, 2008a). Teachers should be educated on such a network of factors. Subsequently, teachers can adopt singing activities to their practice in order to facilitate development in the children's physiological and psychological sides. For example, singing activities and vocal exploration exercises can facilitate appropriate voice production techniques, subsequently posing a positive influence on children's psychological well-being and ability to learn.

The connections between psychological states and their vocal behaviours, as well as the benefits associated with singing activities, should be demonstrated to teachers. When children's psychological well-being is enhanced through singing engagement, children's psychological functions (such as their ability to concentrate) are likely to be improved. For instance, positive biographic feelings and subjective perceptions (i.e. self-confidence, self-esteem, identity) can be facilitated though singing engagement, consequently being reflected in an enhanced ability to concentrate and learn.

245

Singing activities can be used for targeting a variety of psychological aspects (see Chapter 8). For example, the relaxing influence of singing activities can be benefitted from by implementing such activities at the beginning of the school day in order to increase the children's ability to concentrate and learn for the whole day, based on the states of being. It should be noted, however, that teachers need to familiarise children with singing activities in order for children to feel comfortable with engaging in such activities. Moreover, once children are familiar with such activities and find such activities enjoyable, they are more likely to gain maximum benefit from these activities. Singing activities can easily be modified in order for them to be accessible to all children, as well as for addressing individual needs.

Once teachers feel confident as to including singing in their practice, activities can relatively easily be implemented in educational settings on a regular basis. For example, a 10-minute singing session can be implemented at the beginning of the school day. As a consequence of such practice, teachers and children are likely to gain confidence in using their voices and become familiar with engaging in singing activities. Once the various benefits associated with singing activities are stressed to teachers, they are more likely to implement such activities in their practice.

11.2.3 Implications for the sociological perspective

A variety of sociological factors are connected to the network of physiological and psychological factors, as well as to children's vocal behaviours (Barlow and Howard, 2002; Bolfan-Stosic et al., 1998; Nienkerke-Springer et al., 2003) (see Section 10.4.4). The interaction between external (such as sociological) and internal (such as psychological) factors should be demonstrated to teachers in order for them to consider understand that children are simultaneously influenced influenced by a variety of factors.

Moreover, the interaction between different sociological factors should be stressed to teachers (see Section 10.5). For example, gender and local environment may simultaneously shape children's speaking and singing behaviours. Consequently, teachers should be educated in adopting their teaching strategies according to their cultural surroundings. For instance, when a teacher moves from one town to another, they

246

should adjusted their professional practice accordingly in order for them to gain maximum benefit from the education they receive. In addition, the potentially role of linguistic factors in shaping children's vocal products should be highlighted to teachers.

Furthermore, teachers can be educated on how singing activities can potentially be used as a tool to enhance children's social skills and their ability to communication. For instance, teachers can be educated to carry out singing activities when children are in pairs or in small groups. Such a singing activity engage the children as as a group can increase the children's self-confidence in communicating with others. The level of children's self-confidence can be raised by peer-support in such settings, further being reflected in increased confidence in their voice use. Such increased level of confidence in using one's voice can be benefited from in any situation that requires voice use.

Teachers should be educated on the fact that all children, despite their backgrounds, can be encouraged to participate in singing activities through appropriate singing engagement. Singing sessions should be carried out as an all-inclusive group-activity. For instance, girls and boys can equally benefit from such activities.

Moreover, teacher should be educated on the importance of appropriate acoustic environment in the classroom, in which singing activities in order to prevent voice abuse and vocal distortions from manifesting. For example, music lessons the assembly should be carried out in a voice-friendly acoustic environment. In addition, teachers and children should be educated on projecting their voices appropriately despite the acoustic environments, in order to facilitate healthy vocal functioning and to prevent vocal distortions from manifesting. Such education could, for instance, take place through singing activities.

11.3 Suggestions for a therapeutic practice

Traditionally, the primary focus in speech voice therapy settings has been children's speaking behaviour (McAllister, 1997; Rinta and Welch, 2008a; Sederholm, 1996; Wilson, 1987). Previous research has indicated that singing can potentially be a beneficial addition to such settings, but not much evidence can be found on the benefits associated with singing activities. In the current study, implications for the inclusion of singing and a variety of holistic factors in therapeutic settings were formulated, as discussed below.

11.3.1 Implications for a physiological perspective

Similarly to teachers, speech and voice therapists should be educated on the finding that children possess one voice that is used for generating their speaking and singing behaviours, rather than two different voices used for generating distinct vocal behaviours (see Section 10.3). Therapists should be educated on how children's vocal characteristics are connected between the two vocal behaviours (see Chapter 6) (Rinta and Welch, 2008a; Sundberg, 1996; 2001; Welch, 2005). Based on such knowledge, traditional ideas advocating the concept that children possess 'a speaking voice' and 'a singing voice' can be challenged. Therapists can modify their therapy techniques in order to facilitate the concept that children possess one voice that performs as the main instrument for their speaking and singing behaviours. Therapists are, subsequently, more likely to include singing in their practice once they do not possess such clear distinctions between speaking and singing behaviours.

Therapists' awareness of the physiological mechanisms that underlie children's speaking and singing behaviours should be increased. The fact that the children exploit the same vocal structure for generating speaking and singing behaviours should be emphasised to therapists (see Chapter 6) (Hegde, 2007; Rubin et al., 2003; Wilson, 1987; Welch, 2005). The functional differences between the two vocal behaviours should be highlighted to therapists. Vocal exploration techniques integrating speaking and singing behaviours could be used as a means to highlight the connections between these two vocal behaviours. It should be noted, however, that the therapists need to feel confident about adopting singing to their professional practice in order to gain maximum benefit from such activities.

Furthermore, therapists should be educated on the physiological changes taking place as children enter puberty (Mathieson and Greene, 2003; Welch and Howard, 2002). The physiological changes taking place and their influence on the children's vocal products should be highlighted to therapists in order for them to alter their reference-points for 'normal' and 'abnormal' vocal characteristics according to their child client's age. In

248

addition, therapists need to be aware of potential individual differences in the maturing process in order to be able to provide effective intervention for each individual child (Mathieson and Greene, op.cit.; Welch, 1994). Similarly to teachers, the fact that the level of competency in speaking and singing behaviours are not of prime importance should be emphasised to therapists (see Chapter 7).

Furthermore, therapists need to be educated on the culturally-located perceptual 'normality' and 'abnormality' of children's vocal products (see Chapters 6 and 9) (Andrews, 1991; McAllister, 1997; Sederholm, 1996; White, 2001). Voice examples of 'normal' and 'abnormal' vocal characteristics from the culture that the therapist is practicing in would be beneficial for reliable therapeutic practice, particularly when the therapist moves from one culture to another. Such voice examples need to be gathered in further research. Moreover, the cut-off point for 'normal' and 'abnormal' vocal characteristics may vary from culture to culture, with children in particular cultures potentially exhibiting a greater amount of 'abnormal' vocal characteristics (see Chapters 6 and 9).

Any significant connections between independent voice parameters in children's speaking and singing behaviours should be emphasised to therapists in order for them to be able to diagose speech and voice disorders easier. For example, the recorded connection between hoarse voice quality and hyperfunctional vocal distortion could be illustrated to therapists, with such information potentially being of assistance in voice assessment (see Chapter 6) (McAllister, 1996; Sederholm, 1997). Similarly, connections between speech and voice disorders should be highlighted to therapists (see Chapter 8) (Koivusaari, 1996; Mathieson and Greene, 2003). For example, the fact that a child with a speech disorder is more likely to possess an additional vocal distortions should be highlighted to therapists. It should be noted that there may be cultural variation recorded as to the relationships between different voice parameters (see Appendices 2-5), providing further evidence for therapist needing to be aware of their local culture.

Moreover, therapists should be educated in identifying vocal distortions in children's vocal products when the children are singing. Therapy training courses should, therefore, include a session on singing activities and how such activities can be adopted to therapy sessions and to voice assessment with child clients. During such training, therapists should be made aware of the fact that assessing children's singing behaviour may generate additional information on children's voice production process (see Chapter 6). For example, audible inhalation and voice-breaks may point out malfunctional elements in the children's voice production process that are likely to be more evident in singing than in speaking (see Chapter 6). It should be noted that, once therapists feel confidence about engaging in singing and they are aware of the benefits associated with singing activities, they are more likely to implement singing in their practice. For instance, they can use singing in educating children as to appropriate voice production techniques.

11.3.2 Implications for a psychological perspective

Therapists should be educated on the connections between children's physiological and psychological sides through their integrated neural networks that are further likely to be connected to children's vocal behaviours (Butcher et al., 1987; Rinta and Welch, 2008a; Rubin et al., 2003; Thurman and Klitze, 2000). The connections between psychological factors and children's vocal behaviours should be illustrated to therapists in order for therapists to consider such factors in their practice, as well as when assessing the child voice perceptually (see Section 10.4). For example, potential psychological causal and contributing factors behind children's vocal distortions should be highlighted to therapists in order for them to assess these factors with new child clients.

An additional example is the psychological benefits associated with singing activities (such as its relaxing properties) should be demonstrated to therapists in the form of a comprehensive list that they can, then, rely on n their practice (Andrews, 1991; Baars and Gabrielsson, 1997; Bunch, 1997; Deem and Miller, 2000; Grape et al., 2003; Stacy et al., 2002; Ternstrom, 2002). For instance, the fact that singing engagement can increase confidence in voice production and, subsequently, result in enhanced vocal functioning and positive vocal identity should be stressed to therapists (see Chapter 8).

Nevertheless, therapists need to enquire children as to how familiar they are with engaging in singing activities prior to adopting such activities to their practice. With children who have undergone more singing training, singing can be introduced in a straight-forward way, whilst with children who have not participated in singing extensively, such activities can be introduced gradually in order to familiarise these

250

children with such activities and to gain maximum benefit from the activities. For example, rhymes and simple songs used in primary schools can easily be adapted to speech and voice therapy settings.

Furthermore, therapists can be educated in adopting singing as a tool for facilitating positive vocal identity and awareness in children (see Chapter 8) (Bolfan-Stosic et al., 2003; Rinta and Welch, 2008a). Singing can also be used as a tool to increase children's self-esteem and self-confidence, in addition to increasing their feelings of self-worth (see Chapter 8 and Appendix 2) (Hancox and Clifton, 2003; Grape et al., 2003) (see Chapter 8). When a child develops confidence in using their own voice, the child's level of general self-confidence is likely to be increase, further influencing the child's other psychological functions (such as their ability to learn).

Moreover, singing can be used as a flexible tool to target specific psychological factors that are connected to children's vocal behaviours. For example, a depressed emotional state can be treated with uplifting singing activities. Therapists may use singing as a tool to relax the child, further resulting in the subsequent therapy session as being more effective in fulfilling its goal. An alternative way of using singing would be to use it as a means to establish a trusting relationship between the therapist and the child client. Subsequently, effective communication can be facilitated between the two parties.

11.3.3 Implications for the sociological perspective

Therapists should be educated on how a variety of factors from children's local (such as their siblings) and wider environments (such as their linguistic environment), simultaneously being connected to children's vocal behaviours (Barlow and Howard, 2002; Bolfan-Stosic et al., 1998; Nienkerke-Springer et al., 2003). The interplay between a variety of sociological factors and their connections to physiological and psychological factors, as well as to their vocal behaviours, should be emphasised to therapists. An example of such interaction would the connection between local culture, children's psychological well-being and their vocal products (see Chapter 9). Subsequently, therapists would become aware of the fact that children function as holistic entities and how such holistic factors need to be considered in therapy sessions and in assessing for a variety of causal and contributing factors.

251

Furthermore, the importance of considering the sociological context of the therapeutic practice should be highlighted to therapists. For instance, the connections between linguistic factors and children's voice quality should be illustrated to therapists in order for them to understand their need to modify their practice (see Chapter 9). For instance, the fact that the 'normal' vocal characteristics vary from culture to culture and from a linguistic group to a linguistic group should be stressed to therapists. In addition, therapists should be made aware of cultural differences in singing practice in order to introduce such activities to children in an appropriate way.

The social functions of singing should be illustrated to therapists in order for them to be able to adopt singing activities to their practice for children's sociological benefit. For instance, singing activities can be used as a tool to facilitate social interaction in group-setting with a group of child clients when a sociological factor is perceived to be causing psychological distress for the children and, subsequently, interfering with the children's vocal output.

In addition, therapists should assess the child client for potential sociological causal and contributing factors behind the child's vocal distortion. When such a causal factor is detected, a therapist can potentially treat it through appropriate singing activity, as mentioned above. The instsuments used in the current study for gathering information on a variety of psychological and sociological factors factors that are connected to children's vocal behaviours could be used in professional practice (see Chapter 5 and Appendix 1). These instruments with the new perceptual voice assessment protocol could be used at the initial stage of voice assessment, subsequently being supplimented by more in-depth analyses if required.

11.4 Suggestions for further research

Since the current study was of exploratory nature, the tentative findings and the implications arose from the study should be exposed to further investigation. in subsequent research. Therefore, suggestions for further research are proposed below.

Firstly, a systematic study specifically investigating a singing intervention programme designed for speech and voice therapy should be exposed to investigation. A group undergoing a special singing intervention could be compared to a control-group that is not undergoing such intervention. Such a study could more specifically highlight the benefits of singing for such therapeutic practice.

Secondly, the connections between children's 'speaking' and 'singing voices' should be exposed to further investigation with a greater number of children. Voice data from different countries could be gathered in order to investigate whether the interconnection between the two voices differ from culture to culture or whether they are similar across cultures. Individual voice parameters (such as hyperfunctioning or hypernasality) in children's speaking and singing behaviours could be investigated in more detail in order to highlight specific similarities and differences between the two vocal behaviours. Gathering both perceptual and acoustic voice data could highlight different aspects of either integration or segregation between the two vocal behaviours. In addition to the 13 voice parameters focussed on in the current study, additional voice parameters and vocal elements could be included in such a study.

Thirdly, the 'normality' and 'abnormality' of children's vocal products in different cultural contexts should be exposed to further investigation. Such a study could illustrate how different cultures shape children's vocal speaking and singing behaviours. Potential cultural shaping of individual voice parameters could also be exposed to investigation in such a study.

Fourthly, medical examination for specific physiological mechanisms underlying children's speaking and singing behaviours could be conducted. Such an investigation could further highlight connections between children's speaking and singing behaviours, as well as ways in which such connections can be benefitted from in educational and therapeutic settings. The development of physiological mechanisms, as well as the influence of such physiological alterations on children's vocal output could also be investigated in such a study. An additional medical examination could be conducted for investigating the neurological processes underlying the perception, processing and production of speaking and singing behaviours. Moreover, the connections between singing engagement and the development of physiological and neurological elements could be investigated further in a longitudinal study.

Fifthly, the holistic network of physiological, psychological and sociological factors should be exposed to further investigation in order to investigate specific forms of interaction taking place between such factors. Knowledge on such interaction could be of benefit in the prevention of speech and voice distortion, as well as in the treatment of such distortions, in professional practice. Such investigation could further highlight the exact interaction taking place between vocal distortions and a variety of psychological difficulties (such as learning and behavioural difficulties).

Sixthly, a longitudinal study investigating the psychological benefits of singing (such as its relaxing properties) could demonstrate in more detail how singing could be benefitted from in educational and therapeutic settings. Such a study can for example, consist of a pre-planned singing programme that could be monitored closely in order to investigate its full influence on children's psychological side The participant children's subjective experiences and attitudes to singing could also be assessed prior and subsequent to such a singing programme. For example, the relationship between singing and children's vocal identity could be further investigated.

Seventhly, the connections between a variety of sociological factors on children's vocal functioning, voice quality and other aspects of their behaviour could be exposed to further investigation. Specific interaction between global and local sociological factors and children's well-being and behaviours (including their speaking and singing behaviours) could be investigated in more detail in order to be able to use such connections in a beneficial way in therapeutic practice. A cross-cultural comparative study could highlight potential interaction between such factors.

Eighthly, benefits associated with singing activities specifically in educational settings could be exposed to further research. Ideas on how singing could be exploited for children's educational benefit could be further investigated in systematic way. For example, using singing activities as a teaching technique in for other subject disciplines (such as when teaching languages) could be researched in a systematic way.

254

Ninthly, the specially-designed perceptual voice assessment protocol used in the current study could be exposed to further empirical investigation with a greater number of voice examples and with a variety of judges from different cultural backgrounds. Such investigation could potentially generate further evidence on the reliability of the protocol.

11.5 Conclusion

The study indicates that pre-pubertal children possess one voice that used for generating their speaking and singing behaviours, as evidenced in similar vocal characteristics between the two vocal behaviours. The 'normal' and the 'abnormal' characteristics of their own voice are culturally-located and appear to vary from culture to culture.

The study further indicates that pre-pubertal children's vocal behaviours are simultaneously connected to a variety of physiological, psychological and sociological factors. Such factors form a complex network, in which interaction takes place through a variety of routes. In addition, singing appears to possess a positive influence on this network of holistic factors (see Figure 11.1).

In summary, the conclusion for the study is as follows:

1) Pre-pubertal children possess one voice that is used for generating their speaking and singing behaviours, rather than 'a speaking voice' used for speaking behaviour and 'singing voice' used for generating singing behaviour.

2) The 'normality' and 'abnormality' of children's vocal products in their speaking and singing behaviours varies according to children's cultural backgrounds.

3) Children's speaking and singing behaviours are simultaneously influenced by a variety of physiological, psychological and sociological factors. External (such as sociological) and internal (such as psychological) factors form a complex network, in which these factors interact and influence one another. Subsequently, such as network of factors is connected to children's speaking and singing behaviours.

255

4) Singing activities have a positive effect on the network of holistic factors. Therefore, singing can potentially be used as a means to enhance such elements in the network, subsequently influencing children's vocal products.

5) It is beneficial to consider holistic factors and singing in perceptual voice assessment in order to eliminate potential underlying causal and contributing factors for children's speech and voice distortions.

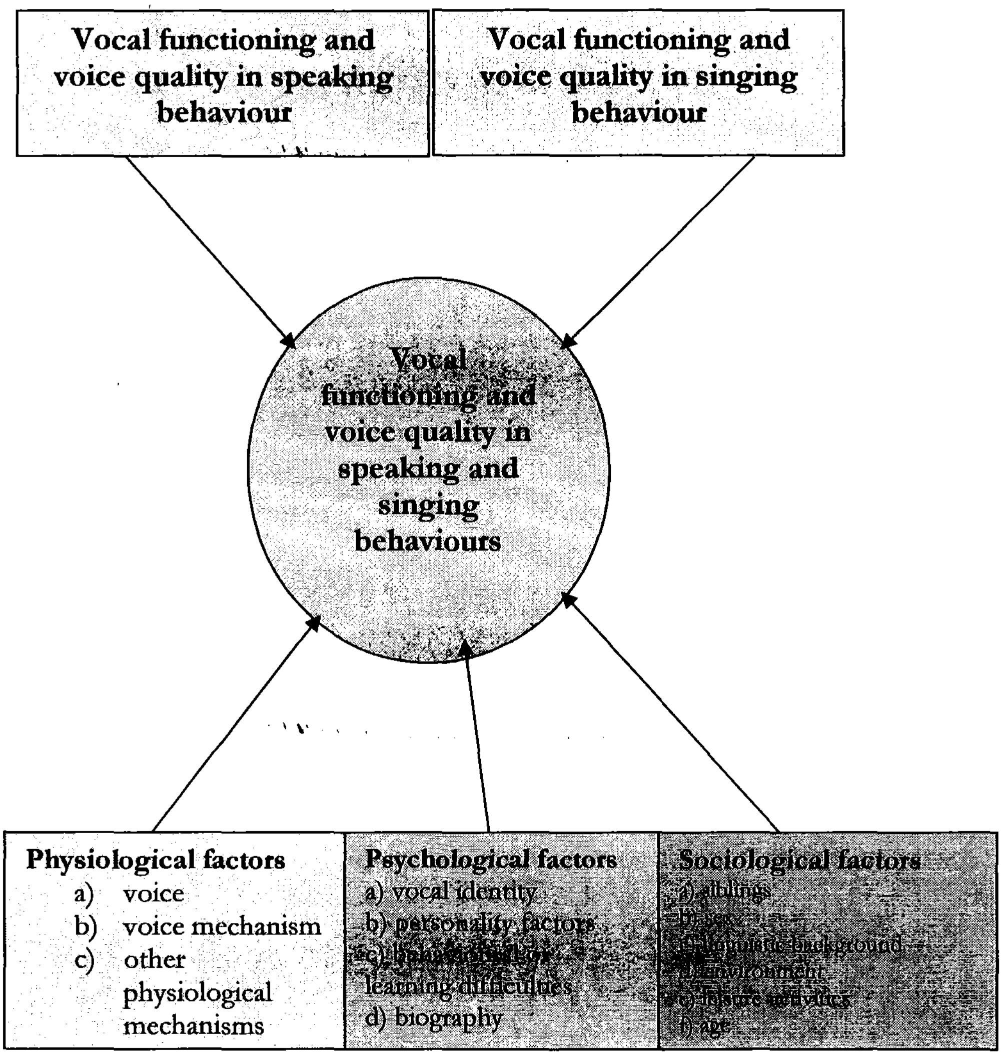


Figure 11.1: A holistic model on pre-pubertal children's vocal functioning and voice quality in their speaking and singing behaviours

256

Bibliography

Adams, C. (2001). Support and Intervention Strategies. In D. Martin and C. Miller (2003). (pp.114-115). *Speech and Language Difficulties in the Classroom.* London: David Fulton

Addo, A.O. (1998). Melody, Language and Development of Singing in the Curriculum. *British Journal of Music Education, 15(2), 139-148*

Alpert, M., Pouget, E.R. and Silva, R.R. (2001). Reflections of Depression in Acoustic Measures of the Patient's Speech. *Journal of Affective Disorders, 66, 123-127*

Altenberg, E. and Ferrand, C. (2006). Fundamental Frequency in Monolingual English, Bilingual Russian/English, Bilingual Chinese English Young Adult Women. *Journal of Voice, 20(1), 89-96*

Altman, K., Atkinson, C. and Lazarus, C. (2005). Current and Emerging Concepts in Muscle Tension Dysphonia: a 30-Month Review. *Journal of Voice, 19(2), 261-267*

Alvin, J. (1991). *Music for the Handicapped Child - Second Edition.* Oxford: Oxford University Press

Amir, O, Amir, N. and Michaeli, O.(2005). Evaluating the Influence of Warm-up on Singing Voice Quality Using Acoustic Measures. *Journal of Voice, 19(2), 252-260*

Anders, L., Hollien, H. , Hurme, P., Sonninen, A. and Wendler, J. (1988). Perception of Hoarseness by Several Classes of Listeners. *Folia Phoniatrica Logopedica, 40, 91-100*

Andrews, M. L. (1991). *Voice Therapy for Children.* Singular Publishing Group, Inc.: San Diego, California

Andrews, M. (2007). Clinical Implications for the Voice of Children. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 10*

Angsuwarangsee, T. and Merrison, M. (2001). Extrinsic Laryngeal Muscular Tension in Patients with Voice Disorders. *Journal of Voice, 16(3), 333-343*

Argnosino, M. (2007). Observation in Qualitative Research. In N.K. Denzin and Y.S. Lincoln(eds.). (pp. 729-745). *The Sage Book of Qualitative Research- Third Edition.* London: Sage Publications, Inc.

Arnold, G.E. (1962). Vocal Nodules and Polyps: Laryngeal Tissues Reaction to Habitual Hyperkinetic Dysphonia. In E. Sederholm (1996). (p.p16-17). Hoarseness in Ten-year-old Children, Perceptual Characteristics, Prevalence and Etiology. *Thesis from the Department of Logaoedics and Phoniatrics Karoliska Institute, Huddinge University Hospital and the Department of Speech, Music and Hearing Royal Institute of Technology (KTH), Stockholm, Sweden*

Aronson, A.E. (1985). Clinical Voice Disorder: an Interdisciplinary Approach, 2nd Edition. In P. White (ed.) (2000). (pp. 132- 133). *Child Voice.* Stockholm: KTH Voice Research Centre

Atkinson, P., Coffey, A., Delamont, S., Lofland, J. and Lofland, L. (eds) (2005). *Handbook of Ethnography.* London: SAGE Publications

Avanzini, G. Faienz Avanzini, G., Faienza, C., Minciacchi, D., Lopez, L. and Majno, M. (eds.)(2003). *The Neurosciences and Music.* New York: New York Academy of Sciences

Baars, G. and Gabrielsson, A. (1997). Emotional Expression in Singing: a Case Study. *Proceedings of the Third Triennal ESCOM Conference, Uppsala, Sweden, 7-12 June,* 479-483

Baker, J. (2002a). Psychogenetic Voice Disorder and Traumatic Stress Experience: a Discussion Paper with Two Case Reports. *Journal of Voice, 17(3), 308-318*

Baker, J. (2002b). Psychogenic Voice Disorders - Heroes or Hysterics? A Brief Overview with Questions and Discussion. *Logaoedics Phoniatrics and Vocology, 27 (8), 84-91*

Ball, V. (1991). Computer-Based Tools for Assessment and Remediation of Speech. *British Journal of Disorders of Communication, 26(1), 95-113*

Barlow, C.A. and Howard, D.M. (2002). Voice Source Changes of Child and Adolescent Subjects Undergoing Singing Training - a Preliminary Study. *Logopedics Phoniatrics Vocology, 27 (2), 66-73*

Baroni, M., Caterina, R., Regazzi, F. and Zanarini, G. (1997). (pp. 484- 489). Emotional Aspects of Singing Voice. *Proceedings of the Third Triennal ESCOM Conference, Uppsala, Sweden, 7-12 June*

Bassey, M. (1999). *Case-study Research in Educational Settings.* Buckingham: Open University Press

Bassich, C.J. and Ludlow, C.L. (1986). The Use of Perceptual Methods by New Clinicians for Assessing Voice Quality. *Journal of Speech and Hearing Disorders, 51, 125-133*

Bastian, R., Thurman, L. and Klitze, C. (2000). Limitations to Vocal Ability from Use-related Injury or Atophy. In L.Thurman and G. F. Welch (eds.) (2000). (pp.527-535). *Bodymind and Voice - Foundations of Voice Education.* Iowa: National Centre for Voice and Speech

Battle, D.E. (2006). The Education of Speech-language Pathologists in the United States of America. *Folia Phoniatrica et Logopedica,* 58(1), 7-13

Batt-Rawden, K. and DeNora, T. (2005). Music and Informal Learning in Everyday Life. *Music Education Research,* 7(3), 289-304

Beck, R.J., Cesario, T.C., Yousefi, A. and Enamoto, H. (2000). Choral Singing, Performance Perception, and Immune System Changes in Salivary Immunoglobulin A and Cortisol. *Music Perception, 18(1), 87-106*

Beech, H.R. and Fransella, F. (1968). *Research and Experimenting in Stuttering.* Oxford: Pergamon

Behlau, M. and Gasporini, G. (2006). Education of Speech-language Pathologists and Audiologists in Brazil. *Folia Phoniatrica et Logopedica, 58(1), 14-22*

Behman, A. (2004). Common Practices of Voice Therapists in the Evaluation of Patients. *Journal of Voice, 19(3), 454-469*

Belin, P. and Zatorre, R. (2003). Adaptation to Speaker's Voice in Right Anterior Temporal Lobe. *NeuroReport, 2105-2109*

Belin, P., Zatorre, R.J., Lafaille, P., Ahad, P. and Pike, B. (2000). Voice-Selective Areas in Human Auditory Cortex. *Nature, 403, 309-312*

Birkenshaw-Flemming, L. (1989). Music and Language Development. In J. Dobbs (1990). (pp. 341-348). *Music Education - Facing the Future.* Chirstchurch, New Zealand: International Society of Music Education.

Birgander, A. (2007). Preveting Voice Disorders in Teachers and Police(wo)men. *Proceddings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 52*

Blood, G.W., Blood, I.M., Maloney, K., Meyer, C. and Qualls, C.D. (2007). Anxiety Levels in Adolescence who Stutter. *Journal of Communication Disorders, 40 (6), 452-469*

Bloodstein, O. (1975). Stuttering.In J. Eisenson and M. Ogilvie (1977). (p. 339-340). *Speech Correction in the Schools - 4th Edition.* USA: Macmillan

Bloor, M. (2005). The Ethnography of Health and Medicine. In P.Atkinson, A. Coffey, S. Delamont, J. Lofland and L. Lofland (eds). (2005). (pp. 177-187). *Handbook of Ethnography.* London: SAGE Publications

Blumental, M. (2006). Interpreters as Assistants in Multilingual Speech and Language Diagnosis. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 108-110*

Blumin, J. H. (2007). Voice Related Quality of Life in Healthy Children: Do Normal Kids Have Voice Problems?. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 13*

Bodt, de M.S., Ketelslagers, K. and Peeters, T. (2007). Evolution of Vocal Fold Nodules from Childhood to Adolescence. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 35-36*

Bohm, B. (2004). Differences in the Speech of 10-to-13 Year-old Boys from Divorced and Non-Divorced Families against the Background of Emotional Attachment. *Folia Phoniatrica et Logopedica, 56, 41-50*

Bohnenkamp, T., Andrews, M., Shrivastav, R. and Summers, A. (2002). Changes in Children's Voices - the Effect of Cognitive Cues. *Journal of Voice, 16(4), 530-543*

Bolfan-Stosic, N. (1998). Acoustical Characteristics of Voice Pathology of School Children. *Utrecht, Voicedata98, Proceedings, 22-26*

Bolfan-Stosic, N. and Prinzl, T. (1998). Jitter and Shimmer Differences between Pathological Voices of School Children. *Proceedings of ICSLP'98, International Conference on Spoken Language Processing, Sydney, Australia, 3, 711-714*

Bolfan-Stosic, N., Tokic, V. and Jelcic-Jaksic, S. (1998). Some Differences of Voice Quality of Children from Different Social Environments. *Proceedings of the 24th IALP, Amsterdam, October, 157-160*

Bolfan-Stosic, N., Yliherva, A. and Welch, G. (2003). Vocal Identities - Differences and Similarities between Children from Croatia and Finland. In I. Manfredi. (2003). (pp. *47-50*). *Models and Analysis of Vocal Emissions for Biomedical Applications. 3rd International Workshop Proceedings, Florence, Italy, Dec 10-12, 2003, Firenze University Press*

Bonet, M. and Cason, P. (1993). Evaluation of Dysphonia in Children's Choir. *Folia Phoniatrica et Logopedica, 46, 27-43*

Bouwers, F. and Dikkers, F. (2007). A Retrospective Study Concerning the Psychosocial Impact of Voice Disorders: Voice Handicap Index Change in Patients With Benign Voice Disorders After Treatment (Measured With the Dutch Version of the VHI). *Journal of Voice. In press. Available online 26 November 2007.*

Bower, J.M. and Parsons, L.M. (2003). Rethinking the "Lesser Brain". *Scientific American, August, 50- 57*

Bowers, D., Bauer, R. and Heilman, K. (1993). A Biological Perspective on Musical Emotions. In P.N. Juslin and J.A. Sloboda (2003). (pp. 112). *Music and Emotions, Theory and Research.* Oxford: Oxford University Press

Brand, E. (2000). Children's Mental Musical Organisations as Highlighted by Their Singing Errors. *Psychology of Music, 28, 62-80*

Brestovci, B. and Bolfan-Stosic, N. (1998). Voice Quality of Hearing-impaired Children. *Proceedings of the 3rd International Workshop, Advances in Quantitative Laryngoscopy, Aachen, June, 19-20, 35-45*

Brown, S., Martinez, M.J., Hodges, D.A., Fox, P.T. and Parsons, L.M. (2004). The Song System of the Human Brain. *Cognitive Brain Research, March, 404-456*

Brumfit, S.N. and Peake, M.D. (1988). A Double-Blind Study of the Verapamil in the Treatment of Stuttering. *British Journal of Disorders of Communication, 23 (1), 35-40*

Bruyninck, M., Harmegnies, B., Llisterri, J. and Poch-Olive, D. (1994). Language-induced Voice Quality Variability in Bilinguals. *Journal of Phonetics, 22, 19-37*

Bryman, A. (2001). *Social Research Methods.* Oxford University Press: New York

Bunch, M. (1997). *Dynamics of the Singing Voice.* New York: Springer

Buck, S., Lees, R. and Cooke, P. (2002). The Influence of Family History of Stuttering on the Onset of Stuttering in Young Children. *Folia Phoniatrica et Logopedica, 54, 117-124*

Bunning, K. (2004). *Speech and Language Therapy Intervention – Frameworks and Processes.* London: Whurr Publishers Ltd.

Bunt, L. (2003). Music Therapy with Children: A Complimentary Service to Education. *British Journal of Music Education, 20 (2), 45-49*

Butcher, E.R. (1993). *Psychogenetic Voice Disorders & Cognitive-behaviour Therapy.* London: Whurr Publishers Ltd.

Butcher, P, Elias, A., Yeatman, J. and Littlejohns, D. (1987). Psychogenetic Voice Disorder Unresponsive to Speech Therapy. *British Journal of Disorders of Communication. 22(1), 81-92*

Butcher, P., Cavalli, L. and Elias, A. (2007). A New Classification System for Psychogenetic Voice Disords. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 93*

Butler, K. and Cheng, L. (1998). Emerging Issues in Child Language. *Folia Phoniatrica et Logopedica, 50, 239-242*

Bybee, A. and Ford, J. (eds.)(2002). *The Modern Singing Master - Essays in the Honour of Cornelius L. Reid.* London: Scarecrow Press

Byrne, M.C. and Shervian, C. C. (1977). *Introduction to Communicative Disorders.* London: Harper&Row

Calciconi, O. (2007). Approaching Surveillance of Voice Hazards in Workplaces: a Proposal of Method. *Proceddings from the 7th Pan European Voice Conference, August 29th – September 1st*

Carding, P.N., Horsley, I.A. and Docherty, G.J. (1999). A Study of the Effectiveness of Voice Therapy in the Treatment of 45 Patients with Non-organic Dysphonia. *Journal of Voice, 13(1), 72-104*

Carding. P.N., Roulstone, S., Northstone, K. and the ALSPAC Study Team (2006). The Prevalence of Childhood Dysphonia: a Cross-Sectional Study. *Journal of Voice, 20(4), 623-630*

Carding, P., Carlson, E., Epstein, R., Mathieson, L. and Shewell, C. (2000). Formal Perceptual Evaluation of Voice Quality in the United Kingdom. *Logopedics Phoniatrics Vocology, 25, 133-138*

Chan, K.M.K. and Yiu, E.M.L. (2006). A Comparison of Two Perceptual Voice Evaluation Training Programs for Naive Listeners. *Journal of Voice,20 (2), 229-241*

Chappell, G. (1995). Childhood Verbal Apraxia and its Treatment. *Journal of Speech and Hearing Disorders, 38(3), 25-30*

Chen, J.L., Zatorre, R.J. and Penhune, V.B. (2006). Interaction between Auditory and Dorsal Premotor Cortex during Synchronization to Musical Rhythms. *NeuroImage, 32, 1771-1781*

Cheng, L.L. (2006). Global Perspective of Speech Pathology Education. *Folia Phoniatrica et Logopedica, 58(1), 5-6*

Clift, S. and Hancox, G. (2001). The Benefits of Singing: Findings from Preliminary Surveys with a University College Choral Society. *Journal of the Royal Society for the Promotion of Health, 121 (4), 248-56*

Cohen, L., Manion, L. and Morison, K. (2000). *Research Methods in Educatio.* Blackwell: UK

Colton, R.H. and Casper, J.K. (1996). *Understanding Voice Problems: a Physiological Perspective for Diagnosis and Treatment.* USA: Lippicott Williams and Wilkins

Connon, N. P., Cohen, S.P., Shannon, M.T., Theieault, L., Heatley, D.G. and Bless, D.M. (2007). Attitudes of Children With Dysphonia. *Journal of Voice. In press. Available online.*

Cooke, S. and Williams, M. (1991), Therapeutic Strategies. In M. Kersner and J. Wright (2002). (pp.60-61). *How to Manage Communication Problems in Young Children.* London: David Fulton

Cooper, M. (1973). *Modern Techniques of Vocal Rehabilitation.* llinois: Charles C. Thomas

Corbin-Lewis and Johnson (2000). (p.24). In R.D. Kent and M.J.Ball (2000). *Voice Quality Measurement* San Diego: Singular Publishing Group

Costa-Giomi, E. (2002). Young Children's Harmonic Perception. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez, and M. Majno (eds.)(2003). (pp. 478-483). *The Neurosciences and Music.* New York: New York Academy of Sciences

Coster, F.W., Goorhuis-Bower, S.M., Nakken, H. and Lutje Spelberg, H.C. (1999). Specific Language Impairment and Behavioural Problems. *Folia Phoniatrica et Logopedica, 51, 99-107*

Cross, I. (2002). Music as Bicultural Phenomenon. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno (eds.)(2003). (pp. 107-111). *The Neurosciences and Music.* New York: New York Academy of Sciences

Daines, B., Fleming, P. and Miller, C. (1996). *Spotlight on Special Educational Needs - Speech & Language Difficulties.* UK: NASEN

David, M. (1995). *The New Voice Pedagogy.* London: Scarecrow Press

Davidson, P.O. (1992). Emotional Change during the Course of Human Development. In P.N. Juslin and J.A. Sloboda (2003). (pp. 90-92). *Music and Emotions, Theory and Research.* Oxford: Oxford University Press

Davis, P. (2005). Voice-Ear-Brain. In J.L.Chapman. (ed.). (2005). (pp. 211- 226).*Singing and Teaching. A Holistic Approach to Classical Voice.* London: Plural Publishing House Inc.

Davis, D.S. (2007). Additional Laws Supporting the Voice-Ear-Brain Connection. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 40*

Davis, P., Zhang, S.P. and Bandler, R. (1993). Pulmonary and Upper Airway Affuent Influences on the Motor Pattern of Vocalisation Evoked by Excitation of the Midbrain Periaqueductal Gray of the Cat. *Brain Research, 607, 57-66*

Davis, S., Shisca, D. and Howell, P. (2006). Anxiety of Speakers who Persist and Recover from Stuttering. *Journal of Communication Disorders, 40 (5), 398-417*

De Cuyper, B. (2007). Emotions and Emotion-management. *Proceddings from the 7th Pan European Voice Conference, August* 29th – *September 1st, p. 38*

De Jong, F.I.C.R.S., Luyckx, B. And Martens, S. (2007). Consciousness of Vocal Risk Fatcors in Student Teachers. *Proceddings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 30*

Decoster, W. (2007). Early Vocal Development: the Backbone of Human Communication. *Proceddings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 12*

Deem, J.F. and Miller, L. (2000). *Manual of Voice Therapy.* Pro-ed, Inc.: Texas

DeJonkeckere, P.H. (2007). Basic Concepts in Functional Voice Therapy – a System for Systematizing and Quantifying the Contents of the Functional Approach. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p.* 66

DeJonckere, P.H. , Obbens, C., de Moor, G.M. and Wieneke, G.H. (1993). Perceptual Evaluation of Dysphonia: Reliably and Relevance. *Folia Phoniatrica et Logopedica, 45, 76-83*

Delamain, N. and Spring, S. (2000). Therapeutic Strategies. In M. Kersner and J. Wright (2002). (pp. 61-63). *How to Manage Communication Problems in Young Children.* London: David Fulton

Deliyski, D.D.,. Shaw, H. S., Evans, M.K. and Vesselinov, R. (2006). Regression Tree Approach to Studying Factors Influencing Acoustic Voice Analysis. *Folia Phoniatrica et Logopedica, 58(4), 274-288*

Deliyski, D., Evans, M.K. and Shaw, H.S. (2004). Influence of Data Acquisition Environment on Accuracy of Acoustic Voice Quality Measurements. *Journal of Voice, 15 (2)116-126*

Deliyski, D. D., Shaw, H.S. and Evans, M.K. (2005). Adverse Effects of Environmental Noise on Acoustic Voice Quality Measurements. *Journal of Voice, 19(2), 176-186*

Demany, L. and Semal, C. (2002). Learning to Perceive Pitch Differences. *The Journal of the Acoustical Society of America, November, 1377-1388*

Demorest, S.M. and Morrison, S.J. (2002). Exploring the Influence of Cultural Familiarity and Expertise on Neurological Responses to Music. In G. Avanzini, C. Faienza, D., Minciacchi, L. Lopez and M. Majno (eds.)(2003). (pp. 338-3407). *The Neurosciences and Music.* New York: New York Academy of Sciences

Denzin, N.K. and Lincoln, Y.S. (eds.) (2007). *The Sage Book of Qualitative Research- Third Edition.* London: Sage Publications, Inc.

Dietrich, M. and Verdolini, K. (2007). The Effects of Acute Stress on Perceived and Objective Extralaryngeal Muscle Tension in Vocally Healthy Subjects. *Proceddings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 39*

Dobbs, J. (1990). *Music Education - Facing the Future.* Chirstchurch, New Zealand: International Society of Music Education.

Dolson, M. (1994). The Pitch of Speech as a Function of Linguistic Community. *Music Perception, 11(1), 321-331*

Drake, C. and El Heni, J.B. (2002). Synchronizing with Music: Intercultural Differences. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno (eds.)(2003). (pp. 428-437). *The Neurosciences and Music.* New York: New York Academy of Sciences

Drennan, W.R. and Watson, C.S. (2001a). Sources of Variation in Profile Analysis. I. Individual Differences and Extended Training. *The Journal of the Acoustical Society of America, 2491-2497*

Drennan, W.R. and Watson, C.S. (2001b). Sources of Variation in Profile Analysis. II. Component Spacing, Dynamic Changes, and Knowing Level. *The Journal of the Acoustical Society of America,* 2498-2504

Durrant, C. (2003). *Choral Conducting: Philosophy and Practice.* London: Routledge

Eadie, T. and Doyle, P.C. (2005). Classification of Dysphonic Voice: Acoustic and Audio-Perceptual Measures. *The Journal of Voice, 19(3), 373-383*

Eder, D. and Fingerson, L. (2002). In J. Gubrium and J.A. Holstein. (2002). (pp.181-201). *Handbook of Interview Research – Context and Method.* London: Sage Publication, Inc.

Einarsdottir, J. (2006). *Nordic childhoods and early education : philosophy, research, policy, and practice in Denmark, Finland, Iceland, Norway, and Sweden.* Oslo: Information Age Publishing

Eisenson, J. and Ogilvie, M. (1977). *Speech Correction in the Schools - 4th Edition,* USA: Macmillan

Elias, A., Raven, R. and Butcher, P. (1983). Speech Therapy for Voice Disorders. *British Journal of Disorders of Communication, 24, 61-76*

Eshnezi, L., Childers, D.G. and Hicks, D.M.(1990). Acoustic Correlates of Vocal Quality. *The Journal of Voice, 33, 298-306*

Ezrati-Vinacour, R. and Levin, I. (2004). The Relationship between Anxiety and Stuttering: a Multidimensional Approach. *Journal of Fluency Disorders, 29 (2), 135-148*

Faienza, C. and Cossu, G. (2000). Introductory Remarks on Musical Beginnings: Ten Years Later. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M.. Majno(eds.)(2003). *The Neurosciences and Music.* (pp. 392-395). New York: New York Academy of Sciences

Fisher, S.E. (2007). Molecular Windowns into Speech and Language Disorders. *Folia Phoniatrica et*

Logopedica, 59(3), 130-140

Flemming, P., Miller, C. and Wright, J. (1997). *Speech and Language Difficulties in Education.* UK: Winslow Press

Fletcher, P. and Hall, D. (eds.)(1992). *Specific Speech & Language Disorders in Children.* London: Whurr Publishers

Fourcin, A. (2005). Hearing and Singing. In J.L.Chapman. (ed.)(2005). (pp. 227-239). *Singing and Teaching. A Holistic Approach to Classical Voice.* London: Plural Publishing House Inc.

Fox, A.V., Dadd, B. and Howard, D. (2002). Risk Factors for Speech Disorders in Children. *International Journal of Language and Communication Disorders, 37(2), 117-131*

Freeman, M. (2000). Voice Development and Change throughout Lifespan. In: M. Freeman, and M. Fawceus (eds.) (2000). (pp. 18-31). *Voice Disorders and their Managements – Third Edition.* Whurr Publishers Ltd.: London

Fredman, M. and Centeno, J. (2006). Recommendations for Working with Bilingual Children. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 23-24*

Freeman, M. And Fawceus, M.(eds.) (2005). *Voice Disorders and Their Managements – Third Edition.* Whurr Publishers Ltd.: London

Freidl, W., Friedrich, G., Egger, J. and Fitzek, T. (1993). Psycho-social Aspects of Functional Dysphonia. *Folia Phoniatrica et Logopedica, 41, 89-144*

French, A. (2006). Measuring Phonological Skills in Adolescence. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 45-47*

Fuchs, M., Meuret, S., Thiel, S., Taschner, R., Dietz, A. and Gelbrich, G. (2007). Influence of Singing Activity, Age, and Sex on Voice Performance Parameters, on Subjects' Perception and Use of Their Voice in Childhood and Adolescence. *Journal of Voice. In press. Available online 30 November 2007.*

Gardner, H. (1977). *The Shattered Mind.* New York: Basic Books,

Gerratt, B.R. and Kreiman, J.(2001). Measuring Vocal Quality with Speech Synthesis. *The Journal of the Acoustical Society of America, 2560-2566*

Geschwind, E. and Galaburda, C. (1985). Biological Basis for Speech and Language Disorders. In: P. Fletcher and D. Hall (eds.) (1992). (pp. 3-11). *Specific Speech and Language Disorders in Children.* London: Whurr Publishers

Glaze, L.E., Bless, D.M. and Susser, R.D. (1990). Acoustical Analysis of Vowel and Loudness Differences in Children's Voice. *Journal of Voice, 4(1), 37-44*

Gordon, N. (1996). Speech, Language and the Cerebellum. *European Journal of Disorders of Communication, 31 (4), 359-367*

Gordon, T., Holland, J. and Lahelma, E. (2005). Ethnographic Research in Educational Settings. In P.Atkinson, A. Coffey, S. Delamont, J. Lofland and L. Lofland (eds). (2005). (pp. 188-203). *Handbook of Ethnography.* London: SAGE Publications

Grape, T., Sandgren, M., Hansson, L., Ericson, M. and Theorell, T. (2003). Does Singing Promote Well-being?: An Empirical Study of Professional and Amateur Singers during a Singing Lesson. *Integrative Physiological & Behavioural Science, 38(1), 65-74*

Grbick, C. (2004). *New Approaches in Social Research.* London: Sage Publications, Inc.

Green, T. (1998). The Reactions of Elementary School Children who Stutter to Social Speech Interactions. *Logaoedics Phoniatrics and Vocology, 23, 3-10*

Groeneveld, D. (2007). Stress-Emotion-Voice. *Proceddings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 38*

Gubrium, J. and Holstein, J.A. (2002). *Handbook of Interview Research – Context and Method.* London: Sage Publication, Inc

Hamdan, A-L., Deeb, R., Sibai, A., Rameh, C., Rigai, H. and Fayyad, H. (2007). Vocal Characteristics in Children With Attention Deficit Hyperactivity Disorder. *Journal of Voice. In press. Available online 14 December 2007*

Hammarberg, B. (1987). Pitch and Quality Characteristics of Mutational Voice Disorders before and after Therapy. *Folia Phoniatrica, 39, 204-216*

Hammarberg, B. (2000). Voice Research and Clinical Needs. *Folia Phoniatrica et Logopedica, 52, 93-102*

Harris, M. and Butterworth, G. (2007). *Developmental Psychology: a Student's Handbook.* London: Psychology Press

Hayasaka, K. (1995). Factors Related to the Onset of Stuttering in Pre-school Children. *Scandinavian Journal of Folia Phoniatrica, 20, 83-89*

Hegde, M.N. (2007). *Treatment Protocols for Stuttering.* Oxford: Plural Publishing, Inc.

Heitmann, R., Asbjornsen, A. and Helland, T. (2004). Attentional Functions in Speech Fluency Disorders. *Logaoedics Phoniatircs and Vocology, 29, 119-127*

Helfrich-Miller, K. (1994). A Clinical Perspective: Melodic Intonation Therapy for Developmental Apraxia. *Clinics in Communication Disorders, 4(3), 34-36*

Hemmarberg, B. (2000). Voice Research and Clinical Needs. *Folia Phoniatrica et Logopedica, 52, 93-102*

Hernando, M., Cobeta, I., Lara, A., Fernando, G. and Gamboa, F.J. (2007). Vocal Pathologies of Difficult Diagnosis. *Journal of Voice. In press. Available online.*

Hesketh, A. and Adams, C. (2000). Assessment of Disorders. In D. Martin and C. Miller (2003). (pp. 112-113). *Speech and Language Difficulties in the Classroom.* London: David Fulton

Hewstone, M., Stroebe, W. and Stephenson, G.M. (1996). *Introduction to Social Psychology – Second Edition.* Blackwell Publishers: Oxford

Hielscher, M. (2004). Comprehension of Emotional Information in Patients with Aphasia. *Folia Phoniatrica et Logopedica, 56, 14-26*

Hillenbrand, J., Cleveland, R.A. and Erickson, R.L. (1994). Acoustic Correlates of Breathy Vocal Quality. *Journal of Speech and Hearing Research, 37, 769-778*

Hirano, M. (1989). Objective Evaluation of the Human Voice: Clinical Aspects. *Folia Phoniatrica et Logopedica, 41, 89-144*

Hixon, T.J. and Hoit, J.D. (1999). Physical Examination of the Abdominal Wall by the Speech Language Pathologist. *American Journal of Speech-Language Pathlogist, 8, 335-346*

Hofmann, S. (2006). Successful Treatment of Vocal Fold Palsy in a Language Different from the Patient's and the Therapist's Mother-tongue. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 15-16*

Hoffman-Ruddy, B. and Sapienza, C.M. (2004). Treating Voice Disorders in the School-based Setting: Working in the Framework of IDEA. *Language, Speech and Hearing Services in the Schools,* 35, 327-332

Hogikyan, N., Thurman, L. and Klitze, C. (2000). How Vocal Abilities Can be Limited by Non-infectious Diseases and Disorders of the Respiratory and Digestive Systems. In L.Thurman and G. F. Welch (eds.) (2000). (p. 592-596). *Bodymind and Voice - Foundations of Voice Education.* Iowa: National Centre for Voice and Speech

Horsley, I. and FitzGibbon, C. (1987). Stuttering Children: Investigation of a Stereotype. *British Journal of Disorders of Communication, 22(1), 19-35*

Howard, D.M. (1997). Practical Voice Measurement.. In T.Harris, J. Rubin, J., S. Harris and D.M. Howard (eds.) (1997). (pp. 323-382). *The Voice Clinic Handbook.* London: Whurr Publishing Company

Huber, J.E., Stathopoulus, E.T., Curione, G.M., Ash, A. and Johhson, K. (1990). Formants of Children, Women and Men: the Effect of Vocal Intensity Variation. The *Journal of the Acoustical Society of America, 1532-1542*

Hunt, J. and Slater, A. (2003). *Working with Children's Voice Disorders.* Oxon, UK: Speechmark Publishing Ltd.

Iitaka, K. (2006). Issues of Japanese Speech Therapy Education Considering the 1995 Guidelines of International Association of Logopedics and Phoniatrics (IALP). *Folia Phoniatrica et Logopedica, 58(1), 41-47*

Iversen, J.R. and Ohgushi, K. (2006). How the Mother Tongue Influences the Musical Ear. *4th ASA/ ASJ Joint Meeting, Honolulu, HI (http://asa.aip.org/honolulu/honolulu.html)*

Iwarsson, J. and Sundberg, J. (1998). Breathing Behaviours during Speech in Healthy Females and Patients with Vocal Fold Nodules. *Speech, Music and Hearing, 4, 23-38*

Jackson-Menaldi, C.A., Dzul, A.I. and Holland, R.W. (2002). Hidden Respiratory Allergies in Voice Users: Treatment Strategies. *Logaoedics Phoniatrics and Vocology, 2 (2)7, 74-79*

Jacobson, B., Johnson, C., Silbergleit, A., Jacobson, G. , Benninger, M.S. and Newman, C.W. (1997). The Voice Handicap INdex (VHI): Development and Validation. *American Journal of Speech-language Pathology - a Journal of Clinical Practice, 6*

Jacoby, P. (1998). Evolutionary Aspects as Holistic Tools in Vocal Pedagogy and Therapy. *Logaoedics Phoniatrics and Vocology, 23, 9-12*

Johnson, J.M. (2002). In-depth Interviewing. In J. Gubrium and J.A. Holstein. *Handbook of Interview Research – Context and Method.* (pp.103-119). London: Sage Publication, Inc.

Johnsrude, I.S., Penhue, V.B. and Zatorre, R.J. (2009). Functional Specificity in the Right Human Auditory Cortex when Receiving Pitch Direction. *Brain, 123, 155-163*

Juslin, P.N. and Sloboda, J.A. (2003). *Music and Emotions, Theory and Research.* Oxford: Oxford University Press

Kalat, J.W. (1999). *Biological Psychology – Sixth Edition.* Brooks/ Cole Publishing Company: London

Karrass, J., Walden, T.A., Conture, E.G., Graham, C.G., Arnold, H.S., Hartfield, K/N. and Schwenk, K.A. (2006). Relation of Emotional Reactivity and Regulation to Childhood Stuttering. *Journal of Communication Disorders, 309 (6), 402-423*

Kazi, R., Kanagalingam, J., Ventikaraman, R., Prasad, V., Clarke, P., Nutting, C.M., Rhys-Evans, P., and Harrington, K.J. (2007). Electroglottographic and Perceptual Evaluation of Tracheoesophageal Speech. *Journal of Voice. In press. Available online 11th May 2007*

Keilmann, A. (2007). Vocal Develpoment in Children. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 12*

Kenny, D.T. and Faunce, G. (2004). The Impact of Group Singing on Mood, Coping, and Perceived Pain in Chronic Pain Patients Attending a Multidisciplinary Pain Clinic. *Journal of Music Therapy, XLI, (3), 241-258.*

Kent, R.D. and Ball, M.J. (2000). Voice Quality Measurement. San Diego: Singular Publishing Group

Kersner, M. and Wright, J. (2002). *How to Manage Communication Problems in Young Children.* London: David Fulton

Kiesel-Himmel, C. and Ohlwein, S. (2003). Characteristics of Children with Permanent Mild Hearing Impairment. *Folia Phoniatrica et Logopedica, 55, 70-79*

Klein, D., Zatorre, R.J., Chen, J., Milner, B., Crane, J., Belin, P. and Bouffard, M. (2006). Bilingual Brain Organization: a Funtional Magnetic Resonance Adaptation Study. *NeuroImage, 31, 366-375*

Klein, D., Watkins, K.E., Zatorre, R.J. and Milner, B. (2006). Word and Nonword Repetition in Bilingual Subjects: a PET Study. *Human Brain Mapping, 27, 153-161*

Kooijman, P.G.C., Jong de, F.I. C.R.S., Oudes, M.J., Huick, W., Acht van, H. and Graamans, K. (2005). Muscular Tension and Body Posture in Relation to Voice Handicap and Voice Quality in Teachers with Persistent Voice Complaints. *Folia Phoniatrica et Logopedica, 57, 134-147*

Kopp, G. (1998). The Role of Singing and Acting in Voice Therapy for Both Hearing and Deaf Persons. *Logaoedics Phoniatrics and Vocology, 23, 27-29*

Kreiman, J. and Gerratt, B.R. (1998). Validity of Rating Scale Measures of Voice Quality. *The Journal of the Acoustical Society of America, 1598-1608*

Kreiman, J. and Gerratt, B.R. (2000). Sources of Listener Disagreement in Voice Quality Assessment. *The Journal of the Acoustical Society of America, 1867-1876*

Kreiman, J., Gerratt, B.R., Precoda, K. and Berke, G. (1992). Individual Differences in Voice Quality Perception. *Journal of Speech and Hearing Research, 35(2), 512-520*

Koivusaari, R. (1998). Voice Disorders in School-aged Children – Persistence of Voice Disorders and their Links to the Psycho-motor Functioning of the Students. *Doctoral Dissertation from the University of Oulu, Finland*

Kopp, G. (1998). The Role of Singing and Acting in Voice Therapy for Both Hearing and Deaf Persons. *Logaoedics Phoniatrics and Vocology, 23, 27-29*

Kracke, I. (1975). Evidence for Non-verbal Deficits. In P. Fletcher and D. Hall (eds.)(1992). (p. 109-112). *Specific Speech & Language Disorders in Children.* London: Whurr Publishers

Kuck, H., Grossbach, M., Bangert, M. and Altenmuller, E. (2000). Brain Processing of Meter and Rhythm in Music. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno (eds.) (2003). (pp. 244-253). *The Neurosciences and Music.* New York: New York Academy of Sciences

Kvale, S. (1996). *InterViews – an Introduction to Qualitative Research Interviewing.* London: SAGE Publications

Laine, M., Tuomainen, J. and Ahonen, A. (1994). Changes in Hemispheric Brain Perfusion Elicited by Melodic Intonation Therapy: a Preminary Experiment with Single Photon Emission Computed Tomography. *Folia Phoniatrica et Logopedica, 19, 19-24*

Lamont, L. (2002). Toddler's Musical Preferences - Musical Preference and Musical Memory in the Early Years. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno (eds.)(2003). (pp. 518-519). *The Neurosciences and Music.* New York: New York Academy of Sciences

Laukka, P. (2004). Vocal Expression of Emotion. *Doctoral dissertation from Uppsala University, Sweden*

Laukkanen, A., Leppanen, K., Tyrni, J. and Vilkman, E. (2005). Immediate Effects of 'Voice Massage' Treatment on the Speaking Voice of Healthy Subjects. *Logaoedics Phoniatircs Vocology, 57, 163-172*

Laurence, F. (1999). Children's Singing. In J. Potter (ed.)(2001). (pp. 221-225). *Cambridge Companion to Singing.* Cambridge: Cambridge University Press

Laver, J.D. (1968). Voice Quality Indexical Information. *British Journal of Disorders of Communication, 3, 43-54*

Law, J. and Miller, C. (2000). Delay, Disorder, Impairment…?. In D. Martin and C. Miller (2003). (pp. 21-22).*Speech and Language Difficulties in the Classroom.* London: David Fulton

Law, J. (1997). Evaluating Intervention for Language Impaired Children: a Review of the Literature. *European Journal of Disorders of Communication, 32, 1-14*

Lazarus, C., Logemann, J., Huang, C. and Rademaker, A. (2003). Effects of Two Types of Tongue Strengthening Exercises in Young Normals. *Folia Phoniatrica et Logopedica, 55, 194-205*

Leighton, G. and Lamont, A. (2006). Exploring Children's Singing Development: Do Experiences in Early Schooling Help or Hinder?. *Music Education Research, 8(3), 311-330*

Leith, W. and Johnston, R. (1986). *Handbook of Voice Therapy for the School Clinician.* London: Taylor&Francis

Leppanen, J.M. and Hietanen, J.K.(2001). Emotion Recognition and Social Adjustment in School-Aged Girls and Boys. *Scandinavian Journal of Psychology, 42, 429-435*

Levman, B.G. (1992). The Genesis of Music and Language. In A. O. Addo (1998). (p. 140). Melody, Language and Development of Singing in the Curriculum. *British Journal of Music Education, 15(2)*

Lewison, G. and Carding,P.(2003). Evaluating UK Research in Speech and Language Therapy. *International Journal of Language and Communication Disorders, 28(1), 65-81*

Lindsay, G., Soloff, N., Law, J., Band, S., Peacay, N., Gascoigne, M. and Radford, J. (2002). Speech and Language Therapy Services to Education in England and Wales. *International Journal of Language and Communication Disorders, 37(3), 273-288*

Long, M.M. (2004). Stamping, Clapping and Chanting: an Ancient Learning Pathway?. *The London Journal of Doctoral Research in Education. 3(1), 11-25*

Lohmander-Agerskov, A., Soderpalm, E., Friede, H. and Lilja, J. (1998). A Comparison of Babbling and Speech at Pre-school of 3-5 Years of Age in Children with Cleft Lip and

Palate Treated with Delayed Hard Palate Closure. *Folia Phoniatrica et Logopedica, 50, 320-334*

Longess, H. (2000). Helping Children's Voices Develop in General Music Education. In L.Thurman and G. F. Welch(eds.) (2000). (pp. 803-813). *Bodymind and Voice, Foundations of Voice Education.* Iowa: National Centre for Voice and Speech

Ma, T. and Yiu, N. (2001). Voice Activity and Participation Profile: Assessing the Impact of Voice Disorders on Voice Disorder Sufferers. *Journal of Speech Language and Hearing Research. 44, 511-524*

Magne, C., Schon, D. and Besson, M. (2002). Prosodic and Melodic Processing in Adults and Children. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno (eds.)(2003). (pp. 460-475). *The Neurosciences and Music.* New York: New York Academy of Sciences

Mang, E. (2001). A Cross-language Comparison of Pre-school Children's Fundamental Frequency in Speech and Song Production. *Research Studies in Music Education, 16, 4-14*

Maqsud, M. (2005). Eysenck's Theory of Personality and Child-adult Emotional Attachments. *Motivation and Emotion, 5(1), 75-83*

Marshall, J., Philips, J. and Goldbart, J. (2006). Professional and Parental Cultures: their Influence on Service Provision in Speech and Language Therapy. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 35-38*

Martin, D. and Miller, C. (2003). *Speech and Language Difficulties in the Classroom.* London: David Fulton

Mason, D. (1999). The Teaching and Learning of Singing. In J. Potter (ed.)(2001). (pp, 204-210). *Cambridge Companion to Singing,* Cambridge: Cambridge University Press

Mathieson, L. (2000). In R.D. Kent and M.J.Ball (2000). (p.28). *Voice Quality Measurement.* San Diego: Singular Publishing Group

Mathieson, L. and Greene, I. (2003). *The Voice & Its Disorders.* London: Whurr Publishers

McAllister, A. (1997). Acoustic, Perceptual and Physiological Studies of Ten-Year-Old Children's Voices. *Dissertation from the Department of Logaoedics and Phoniatrics, Karoliska Institute Huddinge University Hospital and from the Department of Speech, Music and Hearing, Royal Institute of technology (KTH), Stockholm, Sweden*

McCrory, E.(2001). Voice Therapy Outcomes in Vocal Fold Nodules: a Retrospective Audit. *International Journal of Language and Communication Disorders, 35, 19-24*

McFarlane, S.C., Holt-Romeo, T.L., Lavorato, A.S. and Wamer, L. (1991). Unilateral Vocal Fold Paralysis: Perceived Vocal Quality Following Three Methods of Treatment. *American Journal of Speech-language pathology - a Journal of Clinical Practice, 1 (67), 45-48*

McKinnon, D.H. and McLeod, S. (2007). The Prevalence of Stuttering, Voice, and Speech-sound Disorders in Primary School Students in Australia. *Language, Speech, and Hearing Services in Schools, 38, 5-15*

McMullen, E. and Saffran, J.R. (2004). Music and Language: a Developmental Comparison. *Music Perception, 21 (3), 289-311*

McNeill, E.J.M., Wilson, J.A., Clark, S. and Deakin, J. (2007). Perception of Voice in the Transgender Client. *Journal of Voice. In press. Available online 2 April, 2007*

Mendes, A.P., Brown Jr., W.S., Rothman, H.B. and Sapienza, C. (2004). Effects of Singing Training on the Speaking Voice of Voice Majors. *Journal of Voice, 18 (1), 83-89*

Mendes, A.P., Brown, W.S., Sapienza, C. And Rothman, H.B. (2006). Effects of Vocal Training on Respiratory Kinematics during Singing Tasks. *Folia Phoniatrica et Logopedica, 58(5), 363-378*

Mertens, D.M. (2005). *Research and Evaluation in Education and Psychology – Integrating Diversity with Quantitative, Qualitative, and Mixed Methods.* London: Sage Publications, Inc.

Michiel, S., Orey, K., Decoster, W. and De Jong, F.I.C.R.S. (2007). Gender and Vulnerability to Voice Problems. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 39*

Miller, D.G. and Schutte, H.K. (1990). Feedback from Spectrum Analysis Applied to the Singing Voice. *Journal of Voice, 4 (4), 329-334*

Milutinovic, Z. (1994). Social Environment and Incidence of Voice Disturbances in Children. *Folia Phoniatrica et Logopedica, 46, 125-138*

Minciacchi, L., Lopez, S. and M. Majno (eds.)(2003). *The Neurosciences and Music.* New York: New York Academy of Sciences

Ministry of Education (2007). *Education and Culture, Annual Report 2006.* Helsinki, Finland: Ministry of Education

Mitchell, C. (1991). In In R.D. Kent and M.J.Ball (2000). (p.28). *Voice Quality Measurement.* San Diego: Singular Publishing Group

Moerman, M., Martens, J.P., Chevallier, D., Lawson, G., Licht, A.K., Ogut, F., Reckenzaun, E., Woisard, V. and Dejonckere, P. (2007). Evaluation of Substitution Voicing: Development of a Routine Clinical Assessment Protocol and International Data Collection. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st*

Montello, M. (2002). *Essential Musical Intelligence.* Illinois: The Theological Publishing House

Moog, H. (1976). In J. Sloboda (2000). (p. 208). *The Musical Mind - the Cognitive Psychology of Music.* Oxford: Oxford University Press

Moog, H. (1968). *The Musical Experience of the Pre-school Child.* London: Hutchinson

Morton, V. and Watson, D.R. (2001). The Impact of Impaired Vocal Quality on Children's Ability to Process Spoken Language. *Logaoedics Phoniatrics and Vocology, 26, 17-25*

Murdoch, B., Hird, K. and Law, P. (2002). Perception of Synthesized Voice Quality in Connected Speech by Cantonese Speakers. *The Journal of the Acoustical Society of America, June, 1091-1101*

Newham, P. (1993). *The Singing Cure - an Introduction to Voice Movement Therapy.* Massachusets: Shambala Pyblications, Inc.

Nicollas, R., Garrel, R., Ouaknine, M., Giovanni, A., Nazarian, B. and Triglia, J. (2007). Normal Voice in Children Between 6 and 12 Years of Age: Database and Nonlinear Analysis. *Journal of Voice. In press. Available online 18th May 2007*

Nielsen, C.H. and Ramberg, C. (1998). Evaluation of a Scandinavian Intensive Program for Stuttering in Adolescence. *Logaoedics Phoniatrics and Vocology, 23, 66-75*

Nienkerke-Springer, A., McAllister, A. and Sundberg, J. (2003). Effects of Family Therapy on Children's Voices. *Speech, Music and Hearing, 45, 75-85*

Niimi, S. and Miyaji, M. (2000). Vocal Fold Vibration and Voice Quality. *Folia Phoniatrica et Logopedica, 52, 32-38*

Nordoff, P and Robbins, C. (1975). *Music Therapy in Special Education Schools.* USA: Routledge

Oster, A. (2002). Presentation of a New EU Project for Speech Therapy: OLP (Ortho-Logo-Paedia). *Fonetik, 43 (1), 45-48*

Oster, A., House, D., Protopapas, A. and Hatzis, A. (2002). The Relationship between Residual Hearing and Speech Intelligibility – Is There a Measure that Could Predict a Prelingually Profound Deaf Child's Possibility to Develop Intelligible Speech?. *Fonetik, 44, 43, 51-56*

Pabon, P., McAllister, A., Sederholm, E. and Sundberg, J.(2000). Dynamics and Voice Quality Information in the Computer Phonetograms of Children's Voices. In. P. White. *The Child Voice.* (2001). (pp.85-100). Stockholm: KTH Voice Research Centre

Papousek, H. (1996). Musicality in Infancy Research: Biological and Cultural Origins of Early Musicality. In I.Deliege and J.Sloboda (eds.).(1996). (pp. 37-55). *Musical Beginnings.* Oxford: Oxford University Press

Parchalli, A. (2997). Vocal Abuse in Singers, due to Performing Environment and Lifestyle. A Comparison between Greek Entertainment and Greek Musical Singers. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 21*

Patel, A. D. (1998). Syntactic Relations in Language and Music. *Journal of Cognitive Neuroscience,* 10, 717-733

Patel, A.D. (2006). Musical Rhythm, Linguistic Rhythm, and Human Evolution. *Music Perception, 24(1), 99-104*

Patel, A.D. (2007). Language, Music, and the Brain: a Resource-sharing Framework. *Proceedings from the Conference on 'Language and Music as Cognitive Systems, Cambridge University, May 11-13*

Patel, H., Price, C. and Baron, J.C. (1997). The Structural Components of Music Perception. A Functional Anatomical Study. *Brain, 120, 229-243*

Payne, S.L. (1980). *The Art of Asking Questions.* Princeton University Press: US

Pellowski, M.W. and Conture, E.G. (2002). Characteristics of Speech Disfluency and Stuttering Behaviours in 3-4 Year-Old Children. *Journal of Speech Language and Hearing Research, 45, 20-34*

Peretz, I. (2000). Varieties of Musical Disorders – the Montreal Battery of Evaluation of Amusia. Hearing and Speech Intelligibility – Is There a Measure that Could Predict a Prelingually Profound Deaf Child's Possibility to Develop Intelligible Speech?. *Fonetik, 44, 4, 45-58*

Peretz, I. and Coltheart, M. (2003). Modularity of Music Processing. *Nature Neurosciences,* 6 (7), *688-690*

Peretz, I. and Zatorre, R.J. (2005). Brain Organization for Music Processing. *Annual Review of Psychology, 56, 89-114*

Peretz, I., Champod, A.S. and Hyde, K. (2000). Varieties of Musical Disorders - the Montreal Battery of Evaluation of Amusia. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno(eds.)(2003). (p. 58-75). *The Neurosciences and Music.* New York: New York Academy of Sciences

Peretz, I., Cagnon, L., Hebert, S. and Macoir, J. (2004). Singing in the Brain. *Music Perception, 21(3), 373-390*

Perry, D.W., Zatorre, R.J., Petrides, M., Alivisato, B., Meyer, E. and Evans, A.C. (1999). Localisation of Cerebral Activity during Simple Singing. *NeuroReport, 3979-3984*

Pert, C.B. (1986). The Wisdon of the Receptorts: Neuropeptides, the Emotions and Bodymind. *Advances, 3(3), 8-16*

Plantinga, J. and Trainor, L.J. (2002). Long-term Memory for Pitch in Six-month-old Infants. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno(eds.)(2003). (pp. 520-521). *The Neurosciences and Music,* New York: New York Academy of Sciences

Potter, J. (ed.)(2001). *Cambridge Companion to Singing.* (pp. 204-247). Cambridge: Cambridge University Press

Prompt Institute (2006). http://www.promptinstitute.com/

Pouchoulin, G., Fredouille, C., Bonastre, J.-F., Ghio, A. and Giovanni, A. (2997). Frequency-Based Analysis for the Characterization of the Dysphonic Voices. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st*, p. 17

Punch, K.F. (2005). *Introduction to Social Research: Quantitative and Qualitative Approaches –Second Edition.* London: Sage Publications, Inc.

Rantala, L., Vilkman, E. and Bloigu, R. (2002). Subjective Complaints and Objective Measurements for Female Primary and Secondary Schoolteachers. *Journal of Voice, 13(4), 484-495*

Reid, L. (2001). Vocal Mechanics. In A. Bybee and J. Ford (eds.)(2002). (pp. 1-23). *The Modern Singing Master - Essays in the Honour of Cornelius L. Reid.* London: Scarecrow Press

Rethfeldt, S. and Miller, N. (2006). Speaking Fundamental Differences in Highly Proficient German-English Bilinguals. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 24-27*

Rinta, T. (2008). Potential Use of Singing in Education Settings with Pre-pubertal Children Suffering from Spèech and Voice Disorders: Psychological Perspective. *British Journal of Music Education, 25(2), 139-158*

Rinta, T. and Welch, G.F. (2008a). Should Singing be Included in Speech and Voice Therapy Settings with Pre-pubertal Children Suffering from Speech and Voice Disorders?. *Journal of Voice, 17(2), 100-112*

Rinta, T. and Welch, G.F. (2008b). Perceptual Connecitons between Children's Speaking and Singing Behaviours. *Journal of Voice. In press. Available online 9th June 2008*

Robb, M., Gilbert, H. and Lerman, J. (2005). Influence of Gender and Environmental Setting on Voice Onset Time. *Logaoedics Phoniatircs Vocology, 57, 125-133*

Robson, C. (2002). *Real World Research – Second Edition,* Blackwell: UK

Rosen, P.C. and Sataloff, R.T. (1997). *Psychology of Voice Disorders.* Singular Publishing Group, Inc.: London

Rossi, E. (2000). *The Psychobiology of Mind-Body Healing – New Concepts of Therapeutic Hypnosis.* London: Norton & Company, Inc.

Rothman, H.B., Brown, Jr. and LaFond, J.R. (2002). Spectral Changes due to Performance Environment in Singers, Nonsingers, and Actors. *Journal of Voice, 16 (3), 323-332*

Roy, N., Holt, K.I., Redmond, S. and Muntz, H. (2007). Behavioural Characteristics of Children with Vocal Fold Nodules. *Journal of Voice, 21(2), 157-168*

Rubin, J.S. (2005). Vocal and Respiratory Anatomy and Physiology. In J.L.Chapman. (ed.)(2005). (pp. 185-210). *Singing and teaching. A Holistic Approach to Classical Voice.* London: Plural Publishing House Inc.

Rubin, J.S., Blake, E. and Mathieson, L. (2007). Musculoskeletal Patterns in Patients with Voice Disorders. *Journal of Voice, 21(4), 477-484*

Rubin, J., Sataloff, R. and Korovin, G. (2003). *Diagnosis and Treatment of Voice Disorders - Second Edition.* New York: Thomson Delmar Learning

Rutter. M., Macdonals, H.m Le Counteur, A., Harrington, R., Bolton, P. And Bailey, A. (1990). In P. Fletcher and D. Hall (eds.)(1992). (p. 10). *Specific Speech & Language Disorders in Children.* London: Whurr Publishers

Ruzza, B., Rocca, F., Boero, D.L. and Lenti, C. (2002). Investigating the Musical Qualities of Early Infant Sounds. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno (eds.) (2003). (pp. 527-529). *The Neurosciences and Music.* New York: New York Academy of Sciences

Saffran, J.R. (2002). Musical Learning and Language Development. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez, and M. Majno (eds.) (2003). (pp. 397-401). *The Neurosciences and Music.* New York: New York Academy of Sciences

Salameh, E.K. (2006). Linguistic and Cultural Factors Affecting Assessment and Intervention for Bilingual Children with Language Impairment. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 17-18*

Sandbank, G. (1989). Emotional Growth through Music. In J.Dobbs (1990). (pp. 337-340). *Music Education - Facing the Future.* Christchurch, New Zealand: International Society of Music Education

Sandrieser, P. and Schneider, P. (2006). KIDS – a Direct Approach in Stuttering Intervention for Children and Teenagers Aged 2 to 17 Years. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 24-26*

Sapienza, P. and Hoffman, C. (2001). Documentation of Clinical Features. In P. White (ed.) (2000). (pp. 105-128). *Child Voice.* Stockholm: KTH Voice Research Centre

Schalen, L., Andersson, K., Fex, S. and Rudell, R. (1999). Diagnosis of Acute Dysphonia. *Logopedics Phoniatrics and Vocology, 24, 238-141*

Schalkwijk, F. (2000). *Music and People with Developmental Disabilities.* London: Jessica Kingsley

Scharf-Rethfeld, W. And Miller, N. (2006). Speaking Fundamental Frequency Differences in German/English Bilinguals. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 32-34*

Schneider, B. and Bigenzahn, W. (2003). Influence of Glottal Closure Configuration on Vocal Efficacy in Young Normal-Speaking Women. *Journal of Voice, 17(4), 468-480*

Scheiner, E., Hammerschmidt, K. Jurgens, U. and Zwirner, P. (2002). Acoustic Analysis of Developmental Changes and Emotional Expression in the Pre-Verbal Vocalisation of Infants. *Journal of Voice, 16(4), 509-529*

Scheiner, E., Hammerschmidt, K. Jurgens, U. and Zwirner, P. (2004). The Influence of Hearing Impairment on Pre-verbal Emotional Vocalisation of Infants. *Folia Phoniatrica et Logopedica, 56, 27-40*

Schewell, C. (1998). The Effect of Perceptual Training on Ability to Use the Vocal Profile Analysis Scheme. *International Journal of Language and Communication Disorders, 33, 322-6*

Schon, D., Lorber, M.S. and Semenza, C. (2000). Singing: A Selective Deficit in the Retrieval of Musical Intervals. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno (eds.)(2003). (pp. 189-192). *The Neurosciences and Music.* New York: New York Academy of Sciences

Shield, B. and Dockrell, J. E. (2004). Acoustics Design Guidelines and Teacher Strategies for Optimising Learning Conditions in Classroom for Hearing and Hearing Impaired Children. *Engineering and Physical Sciences Research Council Annual Report*

Shritastav, R. and Deliyski, D. (2007). Voice Qualiyu Measurement Perceptual and Physiologic Validation. *Proceddings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 23*

Searle, A. (2000). *Introducing Research and Data in Psychology – a Guide to Methods and Analysis.* London: Routledge

Seashore, C.E. (1967). *Psychology of Music.* New York: Dover

Sederholm, E. (1996). Hoarseness in Ten-year-old Children, Perceptual Characteristics, Prevalence and Etiology. *Thesis from the Department of Logaoedics and Phoniatrics Karoliska Institute, Huddinge University Hospital and the Department of Speech, Music and Hearing Royal Institute of Technology (KTH), Stockholm, Sweden*

Sederholm, E. and McAllister, A. (1997). Group Therapy for Dysphonic Children. *Dissertation from the Department of Logaoedics, Umeå University Hospital, Sweden*

Sederholm, E. and McAllister, A. (2001). Group Therapy for Dysphonic Children. In P. White (ed.) (2001). (pp. 143-149). *Child Voice.* Stockholm: Royal Institute of Technology

Sederholm, E., McAllister, A., Sundberg, J. and Dalkvist, J. (1993). Perceptual Analysis of Child Hoarseness Using Continuous Scales. *Folia Phoniatrica et Logopedica, 18, 73-82*

Seidman, I.E. (1991). *Interviewing as Qualitative Research,* Blackwell: UK

Sell, K. (2005). *The Disciplines of Vocal Pedagogy: towards an Holistic Approach.* Ashgate Publishing House: UK

Sergent, D. and Welch, G.F. (2007). Age-Related Changes in Long-Term Average Spectra of Children's Voices. *Journal of Voice. In press. Available online 15 July 2007*

Shrivastov, R. and Sapienza, C.M. (2003). Objective Measures of Breathy Voice Quality Obtained Using an Auditory Model. *The Journal of the Acoustical Society of America, July, 2217-2224*

Silber, R. (2005). In M.Sodersten, S.Ternstrom and M.Bohman (2005). (p. 34). Loud Speech in Realistic Environment Noise: Phonetogram Data, Perceptual Voice Quality, Subjective Ratings, and Gender Differences in Healthy Speakers. *Journal of Voice, 19 (1), 29-46*

Skelton (2004). In R.D. Kent and M.J.Ball (2000). (p.40). *Voice Quality Measurement.* San Diego: Singular Publishing Group

Sloboda, J. (2000). *The Musical Mind - The Cognitive Psychology of Music.* (pp. 194- 268). Oxford: Oxford University Press

Solberg, L.C., Hoag, L.A. and Beals, L. (1994). Clinical Measurement of Fundamental Frequency in Normal and Dysphonic Voices Using Electronic Tunes. *American Journal of Speech-language pathology - a Journal of Clinical Practice, 3(3), 96-105*

Soderpalm, E. (2006). Education of Speech-language Pathologists around the World. *Folia Phoniatrica et Logopedica, 58(1), 59-63*

Sodersten, M., Ternstrom, S. and Bohman, M.(2005). Loud Speech in Realistic Environment Noise: Phonetogram Data, Perceptual Voice Quality, Subjective ratings, and Gender Differences in Healthy Speakers. *Journal of Voice, 19 (1), 29-46*

Speciale, R. and Cimino, G. (1997). Types of Voice Disorders in Children and the Laryngoscopic Approach. In P. White (ed.) (2000). (pp. 129-142). *Child Voice.* Stockholm: KTH Voice Research Centre

Speyer, R. (2004). The Use of Acoustic Parameters for the Evaluation of Voice Therapy for Dysphonic Patients. *The Journal of European Acoustics Association - International Journal on Acoustics, 90, 520-527*

Speyer, R. (2007). Effects of Voice Therapy: a Systematic Review. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st*, p. 67

Speyer, R., Wieneke, G.H., Van Wijck-Warnaar, I. and Dejonckere, P.H. (2003). Effects of Voice Therapy on the Voice Range Profiles of Dysphonic Patients. *Journal of Voice, 17 (4), 543-556*

Square, P. (1994). Treatment Approaches for Developmental Apraxia of Speech. *Clinics in Communication Disorders, 4(3), 34-37*

Stacy, R., Brittain, K. and Kerr, S. (2002). Singing for Health: an Exploration of the Issues. *Health Education, 102(4), 156-162*

Stathopoulos, E. (1998). Child Voice. *Doctoral dissertation from the Department of Communicative Disorders & Sciences, State University of New York at Buffalo, USA*

Stemple, J.C. (1993). *Voice Therapy – Clinical Studies.* Open University Press: UK

Story, B.H., Titze, I.R. and Hoffman, E.A. (2001). The Relationship of Vocal Tract Shape to Three Vocal Qualities. *The Journal of the Acoustical Society of America, 1651-1667*

Strand, E. (1995). Treatment of Motor Speech Disorders in Children. *Seminars in Speech and Language, 16(2), 67-72*

Sundberg, J. (1987). *The Science of the Singing Voice.* Illinois: Northern Illinois University Press

Sundberg, J. (1996). The Human Voice. In R. Greger and U. Windhorst (eds.) (1996). (pp. 1095-1104). *Comprehensive Human Physiology.* Berlin: Springer

Sundberg, J. (2001). How Vocal Sounds Are Made. In J. Potter (ed.)(2001). (pp. 204-247). *Cambridge Companion to Singing.* Cambridge: Cambridge University Press

Tallal, P. (1985). In P. Fletcher and D. Hall (eds.)(1992). *Specific Speech & Language Disorders in Children.* (p. 63). London: Whurr Publishers

Tanner, K., Roy, N., Ash, A. and Buder, E.H. (2004). Spectral Moments of the Long-term Average Spectrum: Sensitive Indices of Voice Change after Therapy?. *Journal of Voice, 19(2), 211-222*

Tashakkori, A. and Teddlie, C. (2003). *Handbook of Mixed Methods in Social & Behavioural Research.* London: Sage Publications, Inc.

Ter Doest, A. (2007). Successful Voice-technique Education. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 51*

Ternstrom, S.(2002). Choir Acoustics – an Overview of Scientific Research Published to Date. *Speech, Music and Hearing, KTH, Stockholm, 43, 1-8*

Ternstrom, S., Sodersten, M. and Bohman, M. (2005). Cancellation of Stimulated Environmental Noise as a Tool for Measuring Vocal Performance during Noise Exposure. *Journal of Voice, 19 (1), 29-46*

Thaut, M. H. (2000). Neural Basis of Rhythmic Timing Networks in the Human Brain. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno (eds.)(2003). (pp. 365-371). *The Neurosciences and Music.* New York: New York Academy of Sciences

Thomas, R.M. (2003). *Blending Qualitative & Quantitative Research Methods in Theses and Dissertations.* London: Sage Publications, Inc.

Thomas, G. And De Jong, F. (2007). Voice Handicap, Voice Complaints of Student Teachers and Indicated Risk Factors in Relation to Voice Handicap. *Proceddings from the 7th Pan European Voice Conference, August 29th – September 1st*, p. 53

Thomasson, M. (2003). *From Air to Aria. Relevance of Respiratory Behaviour to Voice Function in Classical Western Vocal Art.* Stockholm: Royal Institute of Technology

Thomatis (1987). In M. Montello (2002). (p. 67). *Essential Musical Intelligence.* Illinois: The Theological Publishing House

Thompson, W.F, Schellenberg, E.G. and Husain, G. (2002). Perceiving Prosody in Speech - Effects of Musical Lessons. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez, and M. Majno (eds.)(2003). (pp. 530-532). *The Neurosciences and Music.* New York: New York Academy of Sciences

Thurman, L. (2000). Bodyminds, Human Selves, and Communicative Human Interaction. In L.Thurman and G. F. Welch (eds.) (2000). *Bodymind and Voice - Foundations of Voice Education.* (pp. 134-189). Iowa: National Centre for Voice and Speech

Thurman, L. and Gramsch, S. (2000). Cornerstones of Voice Protection. In L.Thurman and G. F. Welch (eds.) (2000). (pp. 646-691). *Bodymind and Voice - Foundations of Voice Education.* Iowa: National Centre for Voice and Speech

Thurman, L., Emanuele, M.A. and Klitze, C. (2000). How Vocal Abilities Can be Limited by Enodicrine System Diseases and Disorders. In L.Thurman and G. F Welch (eds.) (2000). (pp. 556-563).*Bodymind and Voice - Foundations of Voice Education.* Iowa: National Centre for Voice and Speech

Thurman, L. and Klitze, S. (2000). Foundations for Human Self-expression during Pre-nate, Infant, and Childhood development. In L.Thurman and G. F Welch (eds.) (2000). (p. 666-698). *Bodymind and Voice - Foundations of Voice Education.* Iowa: National Centre for Voice and Speech

Thurman, L. and Welch, G. F. (eds.) (2000). *Bodymind and Voice - Foundations of Voice Education.* Iowa: National Centre for Voice and Speech

Timmermans, B., de Bodt, M.S., Wuyts, F.L. and Gyselinck, Y. (2007). Strengthening Vocal Endurance: a Pilot Study. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 52*

Titze, I.R. (1994). *Principles of Voice Production.* Englewood Cliffs, N.J.: Prentice-Hall Inc.

Titze, I.R. (2004). A Theoretical Study of f0-f1 Interaction with Application to Resonant Speaking and Singing Voice. *Journal of Voice, 18 (3), 292-298*

Tracy, R. (2006). Multilingualism in Early Childhood (and beyond): Myths, Facts, Challenges. *Proceedings from the 6th European Congress for CPLOL, September, 15-17, 48-50*

Travers, M. (2001). Introducing *Qualitative Methods - Qualitative Research through Case Studies.* London: SAGE Publications

Unwin, M.M., Kenny, D.T. and Davis, P.J.(2002). The Effects of Group Singing on Mood. *Psychology of Music, 30 (1), 175-185*

Ustvedt (1976). In H. Gardner (1976). (p. 341). *The Shattered Mind.* New York: Basic Books

Valentine, E. and Evans, C. (2001). The Effects of Solo Singing, Choral Singing and Swimming on Mood and Physiological Indices. *British Journal of Medical Psychology, 74 (1), 115-125*

Van Bezoojien, R. (1995). Sociocultural Aspects of pitch Differences between Japanese and Dutch Women. *Language and Speech, 38(3), 253-265*

Van Borsel, J. (2004). Voice and Resonance Disorders in Genetic Syndromes: a Multi-Analysis. *Folia Phoniatrica et Logopedica, 56, 83-92*

Van Borsel, J., Verniers, I. and Bouvrys, S. (1999). Public Awareness of Stuttering. *Folia Phoniatrica et Logopedica, 51, 124-132*

Van der Coolwijk, G.H.F. and Karsten-Voets, H.M.M. (2007). Breathing Related to Voice Problems. The Use of BIM, Buteyko Institute Method, Breathing Retraining. *Proceddings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 29*

Van der Wel, A. (2007). The Authenticity of Childhood. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st, p. 13*

Van Lierde, K.M., Cauwenberge, P.V., Stevens, I. and Dhooge, I. (2004). Language, Articulation, Voice and Resonance Characteristics in 4 Children with Goldenhar Syndrome: a Pilot Study. *Folia Phoniatrica et Logopedica, 56(3), 131-143*

Van Luin, F. (2007). Coaching Professionla Announcers in Public Services. *Proceedings from the 7th Pan European Voice Conference, August 29th – September 1st*, p. 53

Vastjall, D.(2004). Contextual Influences on Sound Quality Measurement. *The Journal of the European Acoustics Association - International Journal on Acoustics, 90, 155-157*

Velsvik Bele, I. (2004). Reliability in Perceptual Analysis of Voice Quality. *Journal of Voice,19(4), 555-573*

Vertigan, A.E., Theodorost, D.G., Winkworth, A.L. and Gibson, P.G. (2007). A Comparison of Two Approaches to the Treatment of Chronic Cough: Perceptual, Acoustic, and Electroglottographic Outcomes. *Journal of Voice. In press. Available online 10th May 2007*

Vieira, M., McInnes, F.R. and Jack, M.A. (2002). The Influence of Laryngeal Pathologies on Acoustic and Electroglottigraphic Jitter Measures. *The Journal of the Acoustical Society of America,* 1045-1055

Vihman, M.M. (1996). *Phonological Development.* Oxford: Blackwell

Virokannas, M. (1997). Psychological Impact of Speech Disorders. In J. Koivusaari. (1998). (pp.20 and 26). Voice Disorders in School-aged Children – Persistence of Voice Disorders and their Links to the Psycho-motor Functioning of the Students. *Doctoral Dissertation from the University of Oulu, Finland*

Weber-Fox, C. (2001). Neural Systems for Sentence Processing in Stuttering. *Journal of Speech Language and Hearing Research, 44, 814-825*

Weinrich, B., Salz, B. and Hughes, M. (2005). Aerodynamic Measures: Normative Data for Children Ages 6:0 to 10:11 Years. *The Journal of Voice, 19(3), 326-229*

Welch, G., Himonides, E., Saunders, J. Papageorgi, I., Rinta, T., Steward, C., Preti, C., Lani, J., Vraka., M. and Hill., J. (2008). The National Singing Programme for Primary Schools in England: An Initial Baseline Study Overview, February 2008. Official *Report to the British Government.*

Welch, G. F. (1985). A Schema Theory of How Children Learn to Sing in Tune. *Psychology of Music, 13, 3-18*

Welch, G.F. (1994). The Assessment of Singing. *Psychology of Music,* 22, 3-19

Welch, G.F. (1998). Early Childhood Musical Development. *Research Studies in Music Education, 11, 27-41*

Welch, G.F. (2001a).*The Misunderstanding of Music.* London: Institute of Education

Welch, G.F. (2001b). The Developing Voice. In L.Thurman and G. F. Welch (eds.) (2001). (pp. 704-721). *Bodymind and Voice - Foundations of Voice Education.* Iowa: National Centre for Voice and Speech

Welch, G.F. (2001c). Vocal function and dysfunction in children. *Report on the two-year Royal Society ESEP join project grant between the University of Surrey, Roehampton and the Royal Institute of Technology (KTH), Stockholm, Sweden*

Welch, G.F. (2005). Singing as Communication. In D. Miell, R. MacDonald and D.J. Hargreaves (2004) (pp. 239-258). Musical Communication. Oxford University Press: Oxford

Welch, G.F. and Howard, D.M. (2002). Gendered Voice in the Cathedral Choir. *Psychology of Music, 30,* 1, *102-120*

Welch, G. F. and Murao, T. (eds.) (1994). *Onchi and Singing Development - A Cross-Cultural Perspective.* (London: Roehampton Institute

Welch, G.F. and White, P. (1993). The Developing Voice: Education and Vocal Efficiency - A Physical Perspective. *Bulletin of the Council of Research in Music Education, 119, 146-156*

Welch, G. F., Howard, D. M. and Rush, C. (1989). Real-time Visual Feedback in the Development of Vocal Pitch Accuracy in Singing. *Psychology of Music, 17 (2), 146-157*

Welch, G.F., Howard, D.M. and Rush, C. (1989). Real-time Visual Feedback in the Development of Vocal Pitch Accuracy in Singing. *Psychology of Music, 17, 2, 146-157*

Welch, G.F., Sergeant, D.C. and White, P.J. (1996). The Singing Competencies of Five-Year-Old Developing Singers. *Bulletin of the Council for Research in Music Education, 127, 155-162*

Welch, G.F., Sergeant, D.C. and White, P.J. (1997). Age, Sex and Vocal Task as Factors in Singing ´in Tune' During the First Years of Schooling. *Bulletin of the Council for Research in Music Education, 133, 153-160*

White, P. (1997). A Study of the Effects of Vocal Intensity Variation on Children's Voices using Long-average Spectrum Analysis. *Speech, Music and Hearing, 1, 119-131*

White, P. (1998). Formant Frequency Analysis of Children's Spoken and Sung Vowels Using Sweeping Fundamental Frequency Production. *Logopedics, Phoniatrics, and Vocology, 1(2), 43-52*

White, P. (2001). *The Child Voice.* Stockholm: KTH Voice Research Centre

Whiteside, S.P. (2001). Sex-Specific Fundamental and Formant Frequency Patterns in a Cross-Sectional Study. *The Journal of the Acoustical Society of America, 464-478*

Whiteside, S. and Hodgson, C. (1999). Acoustic Characteristics in 6-10-year-old Children´s Voices: Some Preliminary Findings. *Logaoedics Phoniatrics Vocology, 24 (1), 6-13*

Willis, E. and Kenny, D.T. (2007). Relationship between Weight, Speaking Fundamental Frequency, and the Appearance of Phonational Gaps in the Adolescent Male Changing Voice. *Journal of Voice. In press. Available online 23rd January 2007*

Williams, J., Welch, G. and Howard, D. (2005). An exploratory baseline study of boy chorister vocal behaviour and development in an intensive professional context. Logopedics Phoniatrics Vocology, 30(3-4), 158-162

Wilson, D.K. (1987). *Voice Problems of Children – Third Edition.* Wlliams & Wilkins: London

Wilson, D.K. (1987). Management of Voice Disorders in Children and Adolescents. In P. White (ed.) (2000) (pp.131-136). *Child Voice.* Stockholm: KTH Voice Research Centre

Wieser, H. (2000). Music and the Brain - Lessons from Brain Diseases and Some Reflections on the ''Emotional'' Brain. In G. Avanzini, C. Faienza, D. Minciacchi, L. Lopez and M. Majno (eds.)(2003). (pp. 76-93). *The Neurosciences and Music.* New York: New York Academy of Sciences

Wigram, T., Saperston, B. and West, R.(eds.) (1995). *The Arts & Science of Music Therapy: A Handbook.* Overseas Publishers: Netherlands

Williamson, D. (1995). Assessment. In M. Kersner and J. Wright (2002). (p. 61). *How to Manage Communication Problems in Young Children.* London: David Fulton: London

Wong, P.C.M., Parsons, L.M., Martinez, M. and Diehl, R.L. (2004). The Role of the Insular Cortex in Pitch Pattern Perception: the Effect of Linguistic Contexts. *The Journal of Neuroscience, October 13, 24(41), 9153-9160*

Wyke, M. (1976). Phonation. In M. Bunch (1997). (pp. 59-73).*Dynamics of the Singing Voice.* New York: Springer

Wyots, L., Haylen, L., Merten, F., De Bodt, M. and Van de Hayning, P.H.(2001). Normative Voice Range Profiles of Untrained Boys and Girls. *Journal of Voice, 16 (4), 460-464*

Xu, Y. and Sun, Y. (2002). Maximum Speed of Pitch Change and How It May Related to Speech. *The Journal of the Acoustical Society of America, 1399-1413*

Yamaguchi, H., Shrivastav, R. and Andrews, M.L. (2003). A Comparison of Voice Quality Ratings Made by Japanese and American Listeners Using the GRBAS Scale. *Folia Phoniatrica et Logopedica, 55, 147-157*

Yin, R.K. (2003). *Case-study Research – Design and Methods – 3rd Edition.* London: SAGE Publications

Zatorre, R. J. (2007). There's more to Auditory Cortex than Meets the Ear. *Hearing Research, 229, 24-30*

Zatorre, R., Belin, P. and Penhune, V. (2002). Structure and Function of Auditory Cortex: Music and Speech. *Trends in Cognitive Sciences, 6(1), 37-47*

Zatorre, R.J., Evans, A.C. and Meyer, E. (1994). Neural Mechanism Underlying Melodic Perception and Melody for Pitch. *Journal of Neuroscience, 14(4), 1908-1919*

Zetterholm, E. (2002). A Case Study of Successful Voice Imitation. *Logaoedics Phoniatrics and Vocology, 27, 80-83*

Zraick, R., Wendel, K. and Smith-Olinde, L. (2004). Effect of Speaking Task on Perceptual Judgment of the Severity of Dysphonic Voice. *Journal of Voice, 19(4), 574-581*

Appendix 1

1. Formally-established perceptual voice assessment protocols currently used in professional practice

a) **The main elements of the GRBAS-scale** (from Yamaguchi et al., 2003)

TABLE SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

b) **Vocal Profile Analyses (VPA)** (from Carding et al., 2000)

TABLE SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

c) The Buffalo III Voice Profile (from Wilson, 1987)

TABLE SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

2. Own voice assessment protocol

Instruction for the UNITED VOICE - perceptual voice assessment protocol (Tiija Rinta and Graham F. Welch, 2005)

The perceptual voice assessment protocol consists of two sections: one for speech and one for singing. The same voice parameters are included in both sections. The protocol intends to assess the child voice perceptually and a child's vocal functioning more broadly, rather than focussing on speech or singing on its own and in detail.

Each voice parameter is specified in the left side of the protocol, being followed by a continuous line. The continuous line represents the rating scale, which ranges from 1 to 7 with 1 representing 'healthy' voice quality and 7 representing 'severely unhealthy voice quality. The left end of the line (i.e. 1) represents 'normality of' or 'absence of' the particular voice quality stated in the left. The right end of the line (i.e. 7) represents 'abnormality of' or 'severe degree of' the voice quality stated in the right.

The judge is asked to rate each voice parameter separately for both speech and singing. The rating should be conducted by making a cross or a mark on the line on a place that is regarded as representing the quality of the particular parameter most appropriately. For instance, when the judge thinks that the child's voice is fairly rough in speech, the cross should be placed approximately in the middle of the line representing the particular parameter in the speech section.

The judge is asked to continue to mark all the voice qualities in such a manner. In the end of the protocol, you find a section for 'other voice quality'. This space is for the judge to write down any additional voice qualities that have not been included in the protocol or any additional comments on the child's vocal functioning.

The judge is instructed to start the rating process after (s)he has listened to the recordings at least once. The judge may listen to the recordings as many times as (s)he feels is needed in order to make reliable and valid judgements.

Rater= Date= Voice No=

Ratings for speech

Voice Quality

Absence of **Severe degree of**

Hoarse ______________________

Breathy ______________________

Hyperfunctional ______________________

Hypofunctional ______________________

Gratings ______________________

Rough ______________________

Voice breaks ______________________

Unstable pitch/ quality ______________________

Hard glottal attacks ______________________

Vocal fry ______________________

Audible inhalation ______________________

Hypernasality ______________________

Hyponasality ______________________

Pitch ______________________

Low **High**

Register
Chest **Modal** **Falsetto**
low medium high

Any additional comments
(e.g. additional voice quality;
comments on vocal functioning)

Ratings for singing

Voice Quality

DIAGRAM SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

Definitions for voice parameters (adapted from Sederholm, 1996 and Vesvik Bele, 2004)

Hoarse= a harsh voice quality

Breathy= audible noise through inefficient glottal closure, air flow heard

Hyperfunctional= strained, tense vocal sound

Hypofunctional= weak, slack vocal sound

Gratings= high-frequency aperiodic noise

Rough= low-frequency aperiodic noise

Voice breaks= audible breaks in voice production

Unstable pitch/ quality= fluctuations in pitch or voice quality

Hard glottal attack= sudden onset of vowel phonation

Vocal fry= low-frequency perturbation

Audible inhalation= audible inhalation of air during vocalisation

Hypernasality= excess nasal sound

Hyponasality= lack of nasal sound

Pitch=correlate of fundamental frequency

Register= modes of phonation

Please note: There are no formally-established delimitations and criteria for 'normal' and 'abnormal' voice quality characteristics. Preparation was undertaken prior to the judges performing their voice assessment task. Initially, therapists practiced perceptual voice assessment with the use of both speech and singing voice samples, as well as the specially-designed protocol, prior to commencing their actual assessment task. Inter-judge reliability was calculated for this practice part in order to ensure that the judges approached the assessment process similarly. It should be noted that each of the judges had been trained in perceptual voice assessment during their professional careers and, thus, each of them applied criteria to their assessment process on the basis of what they had learnt during their professional training. Examples of voice samples and different voice qualities in both speech and singing were provided for the judges prior to assessment in order for them to familiarise themselves with different voice parameters. Such examples of voice samples are included on a CD at the back of the thesis.

Current Developmental Phase: Speaking and Oral Competency

Listens and responds appropriately, speaks audibly and provides some detail in accounts.

Not evident ______________________________ At all times

Exhibits confidence in talking and provides relevant detail with a clear and appropriate tone of voice.

Not evident ______________________________ At all times

Talks and listens confidently by exploring and communicating ideas and by adapting what one says to the needs of the listener.

Not evident ______________________________ At all times

Develops ideas thoughtfully with clear descriptions and conveyance of opinions and with appropriate use of vocabulary and grammar.

Not evident ______________________________ At all times

Begins to vary expression and vocabulary with the use of standard English in formal situations.

Not evident ______________________________ At all times

Talks with increased confidence by using expressive vocabulary and expression in fluent standard English in formal situations.

Not evident ______________________________ At all times

Uses vocabulary precisely and organises talk in order to communicate clearly with the use of standard English in situations that require it.

Not evident ______________________________ At all times

Talks purposefully with a clear structure with the use of apt vocabulary and appropriate intonation and emphasis in confident use of standard English.

Not evident ______________________________ At all times

Talks with the use of a variety of vocabulary and expression by including a variety of contributions and by the use of standard English.

Not At all times

Current Developmental Phase: Singing Competency

Words of the song of initial interest and chant-like singing

Not evident ______________________________ At all times

At times chanting; other times sustaining tones

Not evident ______________________________ At all times

Sustaining tones with some sensitivity to pitch while remaining in the speaking voice range

Not evident ______________________________ At all times

Wavering between speaking and singing

Not evident ______________________________ At all times

Controlled changes in pitch; general melodic contours followed

Not evident ______________________________ At all times

Use of limited vocal pitch-range

Not evident ______________________________ At all times

Melodic shape and intervals accurate with some changes in tonality

Not evident ______________________________ At all times

Shifting to initial vocal pitch-range

Not evident ______________________________ At all times

No significant melodic or pitch errors

No applicable ______________________________ At all times

Use of extended vocal pitch-range

Not applicable ______________________________ At all times

Please note: Assessment criteria for speaking competency was based on standardised school practice. The classroom teacher applied his/ her professional criteria when assessing each child. The criteria were constructed on the guidelines that were provided for the National Test for Oral Competency. Assessment criteria for singing competency were based on expertise in singing assessment. The criteria were not absolute and, therefore, relied on the assessor's knowledge on singing terminology. The terminology included in the protocol was not complex and any professional working in the voice field should be able to conduct the assessment according to the proposed categories.

---

3. Electronic survey for speech, language and voice therapists

Assessing for causal factors:

Do you consider physiological/ anatomical/ neurological and biological causal factors when assessing the normality and abnormality of the child voice?

Do you assess the above factors with singing?

Why do you concentrate on either speech or singing (depending on the answer to the questions above)?

Do you assess for psychological factors?

Do you assess for sociological/ environmental/ cultural and family factors?

How do you assess for these?

Why do you (not) consider these factors important?

Which protocols do you use in assessing the normality of the child voice?

Why have you chosen these protocols?

Why do you consider them reliable and valid?

Do you think that singing is a more suitable intervention approach with particular voice abnormalities than others?

Do you think that voice should be looked at as an integrated entity rather than speech and singing as separate entities?

Do you feel that there is a connection between speech and voice disorders?

---

4. Interview schedule for speech, language and voice therapists

The Purpose of the Current Study

The purpose of the current study is to gain understanding of the current practices of voice, speech and language therapists in different European countries. The data gathered from the questionnaires will be used as part of the researcher's theses. The main research questions of the study concern the nature of voice assessment and the exploitation of singing in professional practice.

I would ask you to respond to the questions honestly and as comprehensively as possible. I may get back to you with further questions in case of clarification is required or further information. You do not need to answer all the questions if they seem too difficult. The data will only be used for the purpose of the current study and will not be passed on to a third party. No names will be mentioned at any stage. The results of the study may be sent to the participants upon request.

I would ask you to reply as soon as possible or by the 1st of May 2005 at the latest if possible in case you are interested in participating in the study.

Many thanks for your participation and help– it is very much appreciated!

Best wishes,
Tiija Rinta

Understanding Local Approaches in the Assessment of Children's Vocal Functioning and Voice Quality

Background Information:

Gender: Age:

Workplace:

Profession/ Title:

Education:

Length of work in the field:

Length of time spent in the current position:

Percentage of children within your client population:

Age range of the children:

Assessing causal factors:

a) Do you consider physiological/ anatomical/ neurological and biological causal factors when assessing the normality and abnormality of the child voice?

- physiological____________
- anatomical______________
- neurological_____________

b) How do you assess for:

i) Physiological:

ii) Anatomical:

iii) Neurological:

c) Do you assess the above factors with speaking?

d) Do you assess the above factors with singing?

e) Why do you concentrate on either speech or singing (depending on the answer to the questions above)?

f) Do you assess for psychological factors?

- If yes: Why do you assess for them?

  How do you assess for them?

- If no: Why do you not assess for them?

g) Do you assess the factors above with speaking?

e) Do you assess the factors above with singing?

f) Why do you concentrate on either speech or singing (depending on the answer to the question above)?

h) Do you assess for sociological/ environmental/ cultural and family factors?

- social:____________
- environmental:_________________
- cultural:_________________________
- family:__________________________

k) How do you assess for these?

- social:

- environmental:

- cultural:

- family:

Why do you (not) consider these factors important?

Protocols used in the assessment:

a) Which protocols do you use in assessing the normality of the child voice?

b) Do you use different protocols when assessing the abnormality of the child voice?

c) Why have you chosen these protocols?

d) Why do you consider them reliable and valid?

e) Do you always use an established protocol?

f) Why have you chosen to use these protocols?

Participants in the assessment:

a) Is the assessment conducted by one person or is it a team activity?

b) If it is a team activity, how many professionals take part in the assessment and how are the responsibilities and tasks divided between professionals?

c) Is the assessment conducted during one session or over several sessions?

d) Is the child asked questions about his/her vocal behaviour?

e) Are the parents or teachers interviewed about the child's vocal history?

General Opinions:

a) Do you feel that assessing the normality and abnormality of the child voice is a challenging task?

b) Do you use the same rating scales for assessing the child voice as the adult voice?

c) Which voice qualities do you consider the most fundamental ones in the assessment of the abnormalities, and why?

d) Do you think that it is easier to assess for certain speech or voice abnormalities than for others?

e) Do you use perceptual assessment?

f) If yes, does it form a major part of your assessment procedure? If no, why do you not use perceptual assessment?

The Use of Speaking and Singing in the Assessment:

a) When conducting the assessment, do you focus on speech behaviour or singing behaviour, and why?

b) If you also use singing, what kind of tasks do you include in the assessment procedure?

c) Would you recommend the use of singing in assessment for other professionals?

d) Do you think that singing is a more suitable intervention approach with particular voice abnormalities than with others?

e) If you do not use singing to any extent, would you consider doing that?

f) Do you feel that there is not enough evidence on the use of singing in therapeutic settings?

g) Do you think that voice should be looked at as an integrated entity rather than speech and singing as separate entities?

h) Do you feel that there is a connection between speech and voice disorders?

i) Does it make sense to you to think of a voice or speech disorder in holistic terms?

The Use of Singing in Therapy Sessions

a) Do you use any singing activities in your therapy sessions?

b) Why do you/ do you not use singing activities in your therapy sessions?

c) Do you think singing activities can be beneficial from physiological, psychological and sociological perspectives?

---

5. An example interview with a speech and voice therapist

- **1st Interviewee**: a practicing voice and speech therapist in Finland; female; aged 47; 100 per cent of clients are children; in the current workplace for six years; in the profession for 22 years

TR: Interviewer
AY: Interviewee

TR: Do you use any singing activities in your therapy sessions?

AY: Yes - to some extent. Sometimes I do, depending on the client and his problem.

TR: That sounds interesting! What kid of singing activities do you use?

AY: Mainly children's songs, rhymes and so on. Something that the child finds familiar and fun.

TR: Why did you choose these activities and why have you included them in your practice?

AY: To get a better contact to children. Sometimes it is difficult to reach a child.

Many children with autistic features like songs and music and they become more relaxed when they hear singing or music. The therapeutic process then becomes easier.

TR: So you see the therapeutic relationship as holding a great deal of importance. Do these activities seem to hold some other benefits in terms of the vocal output?

AY: Music and singing may help a child to express him/herself easier. Again these autistic children). This will enhance the vocal output. By the way, I have used singing also with one aphasic person many years ago. It was the only possibility to communicate with her.

TR: The communication side of things seems to hold the greatest amount of importance for you. Do you think that the benefits for the child are more of physical or psychological nature?

AY: Both I think. Psychological because they build the contact between a child and a therapist. Physical because they make the child more relaxed. I have also noticed the benefits in my own daughter. She goes to sing in a choir once a week and always comes back in a better temper!

TR: Do these activities that include musical elements form a major part of the activities included in your therapeutic practice?

AY: Not really, I only use them as an extra tool if the situation is difficult and I am not able to examine the child's communication abilities. I also examine children with ADHD and learning problems, and they may have hoarse voice. I haven't realised what to do with those children. Sometimes I have used the questionnaire of Natalja Bolfan-Stosic to get a child to realise his/her vocal abuse. But I don't do any intervention. As we summarised in our workshop in London in 2002 that children's voice problems have been neglected also in logopedics. I mean in practical sense.

TR: That is very true. In other words, you concentrate more on the communication abilities of the child rather than on the vocal quality itself and singing is only a complimentary tool. How, in the first place, did you decide to use singing in your practice?

AY: I use singing rarely. From my own experience I noticed that music could be beneficial. But I usually include singing when the situation is difficult. Child screams or do not want to co-operate and so on. In practice, it works almost every time, so singing and other related activities, like music, using rhythms and so on, may be quite effective compared to just speaking.

TR: Sounds like music and singing can provide something to you in therapeutic settings that the traditional methods can't. With this in mind, would you recommend the use of singing in voice therapy for other therapists?

AY: Of course, I've seen the effect for example in my daughter's behaviour. But if we think about Finnish men, it might not be natural for them. We need to consider the cultural feature. A therapist has to be careful with whom the singing would be effective. Sometimes it may do harm if a child or an adolescent feels it's a kind of pressure. We still think that there are some people who cannot sing. I suppose Graham thinks in his philosophy that this is not true. And I agree, singing should be something which gives fun and enjoyment to us and is not some kind of performance. And it is very natural for small children.

TR: So the use of singing is fairly individual. Is there anything preventing you from using singing in your practice?

AY: I still use it even that I feel music and singing are not my strongest skills.

TR: Would you consider using singing activities to a greater extent in your practice?

AY: Yes, but I feel I could benefit from some courses or support how to use music and singing in my work. I only sing the old typical Finnish children's songs. In Finland there are some speech language therapists who are able to use music in their communication therapies. I think speech therapy and music therapy are near each other and could support in a good way child's development. For example, in France, they have used music in speech therapy for a long time. The basis of the therapy lies on psychomotor perspective. In therapy sessions there is always a pianist and a group of children are doing holistic exercises which are based on rhythm.

TR: So you associate any potential benefits to singing in voice therapy settings?

AY: I think I have answered to this question, but the main point I apply some elements of singing and music in my work as I feel they provide something complimentary.

TR: So you would need more information and evidence on the benefits of singing in therapeutic settings in order to include them in your own practice?

AY: Yes, as mentioned above.

TR: What about then you assess the child voice? Do you include singing in the assessment process?

AY: Sometimes, yes. It may give you ideas of dysfuncitoning that speaking alone does not give you. It depends on what the speech or voice problem seems to be...

TR: Do you use any specific perceptual voice assessment protocols?

AY: Yes, GRBAS is often sued in Finland. Or modified versions of it. Well, there are no standards but this is the protocol that therapists often adopt to their use. Just because it is the only one easily available, not necessarily because it is any better than the other ones. You just need a sort of a baseline, on which to base your judgment. So...Sometimes I just sue my own blank protocol on which I have written the major themes that I should be listening out for.

TR: Do you assess for physiological, psychological and sociological causal factors?

AY: Yes. Of course all of them to some extent since they are all connected. Physiological factors are most important since that is where the problem usually originates from. Psychological ones too, but a lot of the time the child is referred to a psychologist if a very bad psychological problem is detected. Sociological factors seem to be undermined, but even these are taken into consideration if the above factors do not explain a child's voice problem. Problematic voice use may have so many different origins that these needs to be assessed. Unfortunately, not all therapists do this as the focus has long been on physiological factors rather than anything else.

TR: So you may get from a psychologist...Do you involve other people in the assessment tasks too?

AY: Sometimes a ear, nose and throat specialist. But a lot of the time, it is only me in the assessment. We are trained to do it ourselves, only when there is a severe physiological disability or illness, we may involve other people. Psychologists are most often contacted...Just because children may have problems that will cause even more severe psychological problems or vocal dysfunctioning in the future.

TR: Do you feel that assessing the child voice is a challenging task?

AY: It is, because not much is known about the child voice. More scientific knowledge is needed. Otherwise the task will always remain very subjective and perhaps reliant on the therapist.

---

6. Observation schedule at speech and voice clinics and an example observation

Singing activities used:

Speaking activities used:

Voice assessment methods:

Perspectives used in assessment and therapy sessions (i.e. physiological, psychological, sociological):

An example of an observation at a clinic:

(Clinic: Voice therapy Clinic at Sidcup, Kent; date: 10/11/05; patient: 6-year-old boy; session duration: 15 minutes)

Assessment methods:

A detailed physical examination was varied out with the use of voice analysis programmes (phonetogram) and perceptual voice assessment. No particular perceptual voice assessment protocol was used.

Physical examination was carried out by an osteopath and an ear-nose and throat specialist. The voice mechanism was examined for any physiological abnormalities. Specific attention paid to vocal folds and the throat area.

Some psychological factors were considered, although assessing for these factors was fairly informal and it seemed that it did not extend to all possible psychological factors. Emotional state and stress factors were mainly taken into consideration.

Sociological factors were not assessed for in any ways.

In assessment, singing not included. Only speaking focused on. Sustained vowels and spontaneous speaking were looked at.

In a therapy session, singing was not included. Speaking was exploited in different ways. One's vocal functioning was explored via a number of specifically-designed speaking tasks that mainly focused on the ability to produce different sounds. For instance, the ability to /s/ and /r/ were explored with this particular patient since he has problems with producing these particular sounds.

---

7. Singing assessment protocols by Welch (2000) and Rutkowski (1998) referenced in Mang (2001)

a) Vocal Pitch-matching Development (Welch, 2001)

1. The words of the song appear to be the initial centre of interest rather than the melody, singing is often described as "chant-like".
2. There is a growing awareness that vocal pitch can be a conscious process and that changes in vocal pitch are controllable. Sung melodic outline begins to follow the general (macro) contours of the target melody or hey constituent phrases, and self-invented and "schematic" songs "borrow" elements from the child's musical culture.
3. Melodic shape and intervals are mostly accurate, but some changes in tonality may occur, perhaps linked to appropriate singing register usage.
4. No significant melodic or pitch errors in relation to relative simple songs from the singer's musical culture.

b

1. ''Pre-singer'' does not sing but chants the song text.

''Inconsistent Speaking-range Singer'' sometimes chants, sometimes sustains tones and exhibits some sensitivity to pitch but remains in the speaking voice range (usually A2 to C3).

2. ''Speaking-range Singer'' sustains tones and exhibits some sensitivity to pitch but remains in the speaking-voice range (usually A2 to C3).

''Inconsistent Limited Range Singer'' waves between speaking and singing voice and uses a limited range when in singing voice (usually up to F3).

3. ''Limited Range Singer'' exhibits consistent use of limited singing range (usually D3 to F3).

''Inconsistent Initial Range Singer'' sometimes only exhibits use of limited singing range, but other times exhibits use of initial singing range (usually D3 to A3).

4. ''Initial Range Singer'' exhibits consistent use of initial singing range (usually D3 to A3).

''Inconsistent Singer'' sometimes only exhibits use of initial singing range, but other times exhibits use of extended singing range (sings beyond the register lift: B3-flat and above).'

5. ''Singer'' exhibits use of consistent extended singing range (sings beyond the register lift: B3-flat and above).

---

8. Interview schedule for the child participants

Name:

What is the main instrument you use for speaking?

What is the main instrument you use for singing?

Do you like the way your voice sounds when you speak?

How would you describe your voice when you speak?

Do you like the way your voice sounds when you sing?

How would you describe your voice when you sing?

Do you think that your voice is different when you speak in comparison to when you sing?

9. An example of an interview with a child

B: Interviewee (boy aged 9; Old Oak School, London, autumn, 2006; 15/10/; 13:15; length: 2.34 minutes)
TR: Interviewer (researcher)

TR: What is the main instrument you use for speaking? I mean, when you speak, where does the sound come from?

B: Uhm...My mouth. And tongue...You also need your throat. Yeah, it comes from the mouth, mainly.

TR: What about when you sing? What is the main instrument then, making your singing happen?

B: When you sing you usually have a microphone...

TR: If you think about yourself, which physiological element generates the singing from within you?

B: Oh, well, the same as for speaking. And also the voice box that is in my throat.

TR: Do you like the way your voice sounds when you speak?

B: Yes, a lot.

TR: Do you like the way your voice sounds when you sing?

B: Yes. Even more.

TR: How would you describe your voice when you speak?

B: It sounds like...laughing. I laugh a lot!

TR: Does it sound of like anything else than laughing?

B: Hhmm...It sounds normal and good.

TR: How would you describe your voice when you sing?

B: It sounds brilliant!

TR: So you prefer the way your voice sounds in singing to the way it sounds in speech?

B: Yes.

TR: Do you think your voice is different when you speak in comparison to when you sing?

B: No. I think it is the same voice.

---

10. Questionnaires for the child participants

a) First questionnaire

Name:

Do you have many friends?

What do you like to do with your friends?

Please circle the terms below that you think describe your personality.

Talkative	Outgoing
Quiet	Confident
Cheerful	Worried
Happy	Angry

What do you like to do after school and in the weekends?

What do you like doing most at school?

b) Second questionnaire

Name:

Age:

Nationality:

Sex:

Language you speak at home:

Any other languages that you speak:

Number of sisters and brothers who are older than you:

Number of sisters and brothers who are younger than you:

Do you like singing? yes no

Why do you like singing/ why do you not like singing?

How do you feel after a singing session?

Do you have any musical hobbies? yes no

If you do, which hobbies do you have?

Do you sing in your hobby? yes no

How long have you had that hobby for? This year/ Since last year/ For a long time

Do you sing at school? yes no

If you do, do you sing in a choir? yes no

D you sing in the assembly? yes no

Do you sing in the music lesson? yes no

---

11. Eysenck Junior Personality Test

Name:

1. Do you like plenty of excitement going on around you? **YES/ NO**

2. Where you ever greedy by helping yourself to more than your share of anything?

YES/NO

3. Do you always do as you are told to at once? **YES/ NO**

4. Have you ever broken any rules at school? **YES/ NO**

5. Would you enjoy cutting up animals in science class? **YES/ NO**

6. Did you ever take anything that belonged to someone else? **YES/ NO**

7. Do you sometimes like teasing animals? **YES/ NO**

8. Did you ever pretend that you did not hear when someone was calling you?

YES/ NO

9. Would you like to explore an old haunted castle? **YES/ NO**

10. Do you always finish your homework before you play? **YES/ NO**

11. Would it upset you a lot to see a dog that has just been run over? **YES/ NO**

12. Do you rather enjoy teasing other children? **YES/ NO**

13. Are you always quiet when older people are talking? **YES/ NO**

14. Are you in more trouble at school than most children? **YES/ NO**

15. Do you generally pick up papers and rubbish others throw on the classroom floor?

YES/ NO

16. Have you got many different hobbies and interests? **YES/ NO**

17. Would you rather sit and watch than play at parties? **YES/ NO**

18. Would you like to go to the moon on your own? **YES/ NO**

19. Would you like parachute jumping? **YES/ NO**

20. Have you ever been cheeky to your parents? **YES/ NO**

21. Do you often feel lonely? **YES/ NO**

22. Have you ever cheated at a game? **YES/ NO**

23. Would you like to drive or ride on a fast motor bike? **YES/ NO**

12. Letter to parents

Name of Child:

Dear Parent,

I am a doctoral student at the Institute of Education (University of London), conducting research in the field of children's speaking and singing behaviours.
I am intending to collect data on children's speaking and singing behaviours and their vocal products in order to investigate the demands that are placed on children's voices on a daily basis in school-settings, as well as perceived differences or similarities between children's speaking and singing behaviours.

The intention is to record examples of children when they speak and sing. The data collection involves the child speaking spontaneously, reading a chosen text passage and singing two simple melodic lines or songs. All the gathered data is to be treated with in the strictest confidence in line with the ethical requirements of the Institute of Education and British Educational Research Association.

I have been given permission from Old Oak Primary school to carry out my research in your child's classroom. However, I also need parental approval for this.

Please return the slip below if you DO NOT wish your child to participate in this study. Your child's participation would be greatly appreciated!

Best wishes,
Tiija Rinta

I am not willing to let my child participate in the study.

NAME OF CHILD:

SIGNATURE OF PARENT:

DATE:

13. Interview schedule for the classroom teacher

How would you describe the behaviour of this child?

How would you describe the personality of this child?

How does the child behave in the classroom in general?

Which subjects is the child good at school and which ones she/ he seems to enjoy?

Does he/ she participate in the music lessons?

Does he/ she seem to enjoy singing?

---

14. An example of an interview with a classroom teacher

SH: Interviewee (classroom teacher for 9-10-year-olds at Old Oak school, London, 6/12/06, 15.45; duration: 3.12 minutes, ; describing a 9-year-old boy)

TR: Interviewer (researcher)

(Length of interview: 12 minutes; conducted in a quiet classroom)

TR: How would you describe the behaviour of this particular child?

SH: In general, he is pretty obedient. He behaves well, except when he seems to be tired and lose his concentration. Sometimes he is a bit troublesome in the class, with a few of the other boys. He listens to you usually and then he does stop doing whatever he is doing when you ask him to do so....Outside classroom, I think he gets on well with other kids and he has a lot of friends.

TR: How would you describe the personality of this child?

SH: He is very outgoing and extraverted. He would be the first one to volunteer for any activity. He loves being the centre of the attention. He can be very dominating. He is very helpful towards other kids though and he seems to care about his peers.

TR: So you feel that this child listens to you in the classroom and behaves well in general?

SH: Most of the time, yes. Then there are the odd moments when he wants to have his own way without listening to anyone else.

TR: Which subjects is the child good at school and which ones she or he seems to enjoy?

SH: Hhmm...He likes active classes, like P.E. He also seems to enjoy math and computer class.

TR: Does he participate the in the music lessons?

SH: Yes, he does, pretty well. He likes playing the instruments more than doing anything else. He is an active boy that likes doing anything that requires him doing it. He does sing whenever we sing, but he seems to prefer instruments. In general, he is one of the first volunteers to do anything.

TR: So it seems that he also enjoys singing?

SH: Yes, definitely. It is an active hobby also so he seems to like it.

---

15. Observation schedule at schools

Acoustics of classroom:

Behaviour of children in the class:

Acoustics in the hallway:

Behaviour of children in the school yard:

Reading tasks:

Singing tasks:

Speaking tasks:

An example of observation:

(Mankkaanpuron koulu, Finland, 4/11/06; 13:20; a class of 10-year-olds)

'The children read a significant amount in their class and, therefore the majority of them are fluent readers. They are able to read fairly complex text-passages. They practice reading the schools library every week for at least two hours in total. At the moment, the children are reading a book by a well-known writer in Finland. The book is called 'Muumin's House'. A text-passage from the book will be used as a reading task in the voice recording part of the experiment.

The children sing for 15 minutes everyday at school. They are used to singing a variety of songs. The children have also learnt to memorise songs and, therefore, they are able to select their own songs for the singing tasks in the experiment.'

---

16. Speaking and singing tasks used as tools for gathering voice data in the voice recordings

a) Reading from a pre-selected text passage:

'Britain is an island. It may seem a large island, but nowhere is more than 200 kilometers from the sea. The sea is very important to people who live on islands. We fish in the sea for food and we use ships on the sea to bring food and goods to us. Many islands, for example, the islands in the Caribbean Sea, are much smaller than Britain, and the islanders may need to bring almost all their food from elsewhere and sometimes drinking water too.'

From: Durbin, C. (2004). *Islands.* UK: Hodder Wayland

b) Spontaneous speaking as provoked by the three pictures below:

Questions posted by the researcher:

'Can you please describe the picture to me?'

IMAGE SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

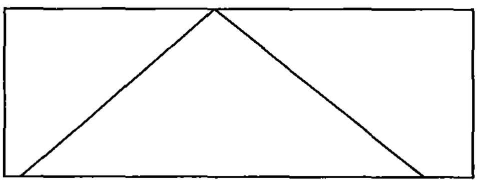
c) Informal interviewing through the following questions:

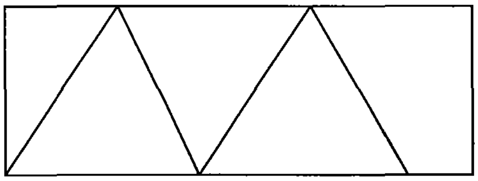
'What do you like to do after school?'

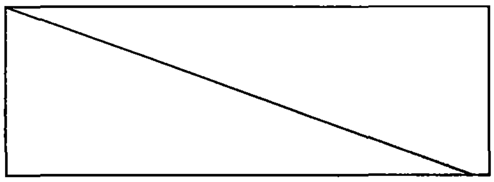
'What is your favourite animal and why?'

'Do you have a favourite book? Which one and why?'

d) Pitch-glides as indicated by the following lines:







e) Singing a song:

Twinkle, Twinkle Little Star

MUSIC SCORE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

[redacted]

17. Interview schedule for investigating the reliability and the validity of the designed perceptual voice assessment protocol

1. Do you feel that the assessment protocol was a reliable tool in carrying out the perceptual voice assessment for a child client?

2. Do you think that this particular protocol would be a useful addition to professional speech and voice therapy practice?

3. Do you think that the protocol offers new elements to professional practice?

4. Are there any elements or aspects in overall voice quality and vocal functioning that could be added to the protocol in order to make it an even better assessment tool?

5. Do you think that the continuous lines are a valid and reliable measure for performing valid assessment in comparison to numbered categories?

An example of an interview with a speech therapist

(J: one of the judges; professional speech and voice therapist; has been practicing for a number of years; a part of clients are pre-pubertal children; length of interview: 5.23 minutes; date: 13/5/06, 14:21)

TR: Do you feel that the assessment protocol was a reliable tool in carrying out the perceptual voice assessment for a child client?

J: Yes, it is very reliable. It covers the voice fairly extensively and takes different aspects into consideration. It is clearly laid out and easy to use. As long as you give clear instructions as to how to use the protocol prior to conducting any assessment, there should be no problems. I would say it is a reliable tool with its instructions. Also, the detail of voice qualities and functioning it gives is useful. At the same time, it looks at voice in more general terms in a reliable way. It is a valid instrument. It brings about good information on the child's vocal functioning and voice quality.

TR: Do you think that this particular protocol would be a useful addition to professional speech and voice therapy practice?

J: Yes, I definitely think so. There is a lack of formally established protocols in the field. This one is very good in the sense that includes both speech and singing in it. Such a protocol has never before been formulated, although may really be the child's singing behaviour that is causing his voice to be distorted. So both behaviours should be taken into consideration. Also, there are no particular protocols designed for assessing the child voice as such, so this protocol should be very useful.

TR: Do you think that the protocol offers new elements to professional practice?

J: Yes, as I said, it is very good to consider both speech and singing. Particularly with some clients. It is good that the same parameters and elements are included in both the section for speech and that for singing. Then you can compare the outcomes from the assessments of the two vocal behaviours. Also, the extra space in the end for additional comments is useful.

TR: Are there any elements or aspects in overall voice quality and vocal functioning that could be added to the protocol in order to make it an even better assessment tool?

J: Hhmm...Well, one parameters...Creaky. Children often speak with a voice that could be characterised as creaky. That could be a beneficial addition. Other than that, I think the protocol covers the voice fairly extensively and comprehensively.

TR: Do you think that the continuous lines are a valid and reliable measure for performing valid assessment in comparison to numbered categories?

J: Yes, the continuous lines seem to work fine. At least not data is lost due to they being constraint to too few categories. It is perhaps more objective this way. As long as the lines are exactly the same length for each parameter.

---

18. Voice examples on the CD (attached to the back cover of the thesis)

The CD on the back cover of the thesis includes a sample of examples of the voice recordings conducted for the study. The CD includes examples of 'normal' and 'abnormal' overall voice quality, as well as examples of voice distortions. The voice examples are from the 10-year-old English participants since the Finnish education authority regarded auditory data as too confidential to be included on the CD.

1. 'Normal' speech
2. 'Normal' singing
3. 'Abnormal' speech
4. 'Abnormal' singing
5. Hoarse voice quality
6. Rough voice quality

7. Voice gratings in speech
8. Vocal fry in singing
9. Hypernasal voice quality
10. Unstable pitch in pitch-glides

---

19. Tables and figures for Chapters 6-9

			speech	singing
Spearman's rho	speech	Correlation Coefficient	1.000	.625(**)
		Sig. (2-tailed)	.	.000
		N	81	81
	singing	Correlation Coefficient	.625(**)	1.000
		Sig. (2-tailed)	.000	.
		N	81	81

Table 1: Spearman's Correlation for overall voice quality ratings in speech and overall voice quality ratings in singing for the whole class

			modsp	modsing
Spearman's rho	modsp	Correlation Coefficient	1.000	.489(*)
		Sig. (2-tailed)	.	.022
		N	52	52
	modsing	Correlation Coefficient	.489(*)	1.000
		Sig. (2-tailed)	.022	.
		N	52	52

Table 2: Relationship between mode for voice quality in speech and mode for voice quality in singing

			medsp	medsin
Spearman's rho	medsp	Correlation Coefficient	1.000	.851(**)
		Sig. (2-tailed)	.	.000
		N	52	52
	medsin	Correlation Coefficient	.851(**)	1.000
		Sig. (2-tailed)	.000	.
		N	52	52

Table 3: Relationship between median for voice quality in speech and median for voice quality in singing

			stsinging	stspeech
Spearman's rho	stsinging	Correlation Coefficient	1.000	.353(*)
		Sig. (2-tailed)	.	.025
		N	52	52
	stspeech	Correlation Coefficient	.353(*)	1.000
		Sig. (2-tailed)	.025	.
		N	52	52

Table 4: Relationship between standard deviation for voice quality in speech and standard deviation for voice quality in singing

Wilcoxon signed rank test		Sig. 2-tailed
Pair 1	speech1 - singing14	.129
Pair 2	speech2 - singing15	.016
Pair 3	speech3 - singing16	.013
Pair 4	speech4 - singing17	.043
Pair 5	speech5 - singing18	.010
Pair 6	speech6 - singing19	.036
Pair 7	speech7 - singing20	.020
Pair 8	speech8 - singing21	.080
Pair 9	speech9 - singing22	1.000
Pair 10	speech10 - singing23	.011
Pair 11	speech11 - singing24	.683
Pair 12	speech12 - singing25	.096
Pair 13	speech13 - singing26	.798

Table 5: Wilcoxon signed-rank test for 2 related samplefor the relationship between voice quality in speech and voice quality in singing for each voice parameter

		hyperf	hoarse
hyperf	Spearman's rho	1	.603(**)
	Sig. (2-tailed)		.000
	N	76	76
hoarse	Spearman's rho	.603(**)	1
	Sig. (2-tailed)	.000	
	N	76	76

Table 6: Relationship between hoarse voice quality And hyperfunctional vocal functioning in speech and singing

		hyperf	breathy
hyperf	Spearman's rho	1	.420(**)
	Sig. (2-tailed)		.000
	N	76	76
breathy	Spearman's rho	.420(**)	1
	Sig. (2-tailed)	.000	
	N	76	76

Table 7: Relationship between breathy voice quality and hyperfunctional vocal functioning in speech and singing

		hoarse	rough
hoarse	Spearman's rho	1	.496(**)
	Sig. (2-tailed)		.000
	N	76	76
rough	Spearman's rho	.496(**)	1
	Sig. (2-tailed)	.000	
	N	76	76

Table 8: Relationship between hoarse and rough Voice quality in speech and singing

		rough	hyperf
rough	Spearman's rho	1	.611(**)
	Sig. (2-tailed)		.000
	N	76	76
hyperf	Spearman's rho	.611(**)	1
	Sig. (2-tailed)	.000	
	N	76	76

Table 9: Relationship between rough voice quality and hyperfunctional vocal functioning in speech and singing

		hyperf	gratings
hyperf	Spearman's rho	1	.422(**)
	Sig. (2-tailed)		.000
	N	76	76
gratings	Spearman's rho	.422(**)	1
	Sig. (2-tailed)	.000	
	N	76	76

Table 10: Relationship between voice gratings and hyperfunctional vocal functioning in speech and singing

Chi-square		Assump.sig.
comp	speech1 - hoarse	0.015
comp	speech2 - breathy	0.083
comp	speech3 - hyperfunctional	0.249
comp	speech4 - hypofunctional	0.115
comp	speech5 - gratings	0.257
comp	speech6 - rough	0.026
comp	speech7 - breaks	0.606
comp	speech8 - unstable	0.352
comp	speech9 – glottal attack	0.521
comp	speech10 – vocal fry	0.520
comp	speech11 - inhalation	0.912
comp	speech12 - hypernasal	0.912
comp	speech13 - hyponasal	0.287

Table 11: Non-parametric Kruswall Wallace test for the relationship between perceived speaking competency and individual voice parameters in speech

Chi-square		Assump.sig.
comp	sing1 - hoarse	0.175
comp	sing2 - breathy	0.396
comp	sing3 - hyperfunctional	0.300
comp	sing4 - hypofunctional	0.722
comp	sing5 - gratings	0.576
comp	sing6 - rough	0.404
comp	sing7 - breaks	0.389
comp	sing8 - unstable	0.160
comp	sing9 – glottal attack	0.245
comp	sing10 – vocal fry	0.439
comp	sing11 - inhalation	0.390
comp	sing12 - hypernasal	0.728
comp	sing13 - hyponasal	0.514

Table 12: Non-parametric Kruswall Wallace test for the relationship between perceived speaking competency and individual voice parameters in singing

		Speech competency	Voice quality in speech
Speech competency	Spearman's rho	1	-.054
	Sig. (2-tailed)		.645
	N	76	76
Voice quality in speech	Spearman's rho	-.054	1
	Sig. (2-tailed)	.645	
	N	76	76

Table 13: Correlation between perceived speaking competency and overall voice quality in speech for the whole participant group

		Speech competency	Voice quality in singing
Speech competency	Spearman's rho	1	.003
	Sig. (2-tailed)		.981
	N	76	76
Voice quality singing	Spearman's rho	.003	1
	Sig. (2-tailed)	.981	
	N	76	76

Table 14: Correlation between perceived speaking competency and overall voice quality in singing for the whole participant group

			qualitysp	speech
Spearman's rho	qualitysp	Correlation Coefficient	1.000	-.148
		Sig. (2-tailed)	.	.812
		N	5	5
	speech	Correlation Coefficient	-.148	1.000
		Sig. (2-tailed)	.812	.
		N	5	5

Table 15: Correlation between perceived speaking competency and overall voice quality in speech for the participants with unhealthy overall voice quality

			speech	qualitysg
Spearman's rho	speech	Correlation Coefficient	1.000	.740
		Sig. (2-tailed)	.	.152
		N	5	5
	qualitysg	Correlation Coefficient	.740	1.000
		Sig. (2-tailed)	.152	.
		N	5	5

Table 16: Correlation between perceived speaking competency and overall voice quality in singing for the participants with unhealthy overall voice quality

			qualitysg	singing
Spearman's rho	qualitysg	Correlation Coefficient	1.000	.181
		Sig. (2-tailed)	.	.770
		N	5	5
	singing	Correlation Coefficient	.181	1.000
		Sig. (2-tailed)	.770	.
		N	5	5

Table 17: Correlation between perceived singing competency and overall voice quality in singing for the participants with unhealthy overall voice quality

			singing	qualitysp
Spearman's rho	singing	Correlation Coefficient	1.000	-.725
		Sig. (2-tailed)	.	.165
		N	5	5
	qualitysp	Correlation Coefficient	-.725	1.000
		Sig. (2-tailed)	.165	.
		N	5	5

Table 18: Correlation between perceived singing competency and overall voice quality in speech for the participants with unhealthy overall voice quality

Chi-square		Assump.sig.
comp	sing1-hoarse	0.244
comp	sing2 - breathy	0.929
comp	sing3 - hyperfunctional	0.458
comp	sing4 - hypofunctional	0.851
comp	sing5 - gratings	0.639
comp	sing6 - rough	0.148
comp	sing7 - breaks	0.632
comp	sing8 - unstable	0.178
comp	sing9 – glottal attack	0.426
comp	sing10 – vocal fry	0.763
comp	sing11 - inhalation	0.494
comp	sing12 - hypernasal	0.098
comp	sing13 - hyponasal	0.135

Table 19: Non-parametric Kruswall Wallace test for the relationship between perceived singing competency and individual voice parameters in singing

Chi-square		Assump.sig.
comp	speech1-hoarse	0.213
comp	speech2 - breathy	0.229
comp	speech3 - hyperfunctional	0.129
comp	speech4 - hypofunctional	0.226
comp	speech5 - gratings	0.400
comp	speech6 - rough	0.274
comp	speech7 - breaks	0.186
comp	speech8 - unstable	0.016
comp	speech9 – glottal attack	0.302
comp	speech10 – vocal fry	0.923
comp	speech11 - inhalation	0.240
comp	speech12 - hypernasal	0.069
comp	speech13 - hyponasal	0.230

Table 20: Non-parametric Kruswall Wallace test for the relationship between perceived singing competency and individual voice parameters in speech

		Voice quality in singing	Singing competency
Voice quality in sing	Spearman's rho	1	.192
	Sig. (2-tailed)		.096
	N	76	76
Singing competency	Spearman's rho	.192	1
	Sig. (2-tailed)	.096	
	N	76	76

Table 21: Correlation between perceived singing competency and overall voice quality in singing for the whole participant group

		Singing competency	Voice quality in speech
Singing competency	Spearman's rho	1	.094
	Sig. (2-tailed)		.421
	N	76	76
Voice quality in speech	Spearman's rho	.094	1
	Sig. (2-tailed)	.421	
	N	76	76

Table 22: Correlation between perceived singing competency and overall voice quality in speech for the whole participant group

			qualitysp	speech
Spearman's rho	qualitysp	Correlation Coefficient	1.000	.421
		Sig. (2-tailed)	.	.198
		N	11	11
	singing	Correlation Coefficient	.421	1.000
		Sig. (2-tailed)	.198	.
		N	11	11

Table 23: Correlation between perceived singing competency and overall voice quality in speech for the participants with unhealthy overall voice quality

			qualitysg	qualitysg
Spearman's rho	singing	Correlation Coefficient	1.000	.333
		Sig. (2-tailed)	.	.318
		N	11	11
	qualitysg	Correlation Coefficient	.333	1.000
		Sig. (2-tailed)	.318	.
		N	11	11

Table 24: Correlation between perceived singing competency and overall voice quality in singing for the participants with unhealthy overall voice quality

			qualitysg	singing
Spearman's rho	qualitysg	Correlation Coefficient	1.000	-.028
		Sig. (2-tailed)	.	.934
		N	11	11
	singing	Correlation Coefficient	-.028	1.000
		Sig. (2-tailed)	.934	.
		N	11	11

Table 25: Correlation between perceived singing competency and overall voice quality in singing for the participants with healthy overall voice quality

			singing	qualitysp
Spearman's rho	singing	Correlation Coefficient	1.000	-.069
		Sig. (2-tailed)	.	.839
		N	11	11
	qualitysp	Correlation Coefficient	-.069	1.000
		Sig. (2-tailed)	.839	.
		N	11	11

Table 26: Correlation between perceived singing competency and overall voice quality in speech for the participants with healthy overall voice quality

		Voice quality in speech	Speech difficutly
Voice quality in speech	Spearman's rho	1	-.195
	Sig. (2-tailed)		.091
	N	76	76
Speech difficulty	Spearman's rho	-.195	1
	Sig. (2-tailed)	.091	
	N	76	76

Table 27: Correlation between speech difficulty and children's overall voice quality in speech

		Speech difficulty	Voice quality in singing
Speech difficulty	Spearman's rho	1	-.399(**)
	Sig. (2-tailed)		.000
	N	76	76
Voice quality in singing	Spearman's rho	-.399(**)	1
	Sig. (2-tailed)	.000	
	N	76	76

Table 28: Correlation between speech difficulty and children's overall voice quality in singing

		Voice quality in speech	Reading difficulty
Voice quality in speech	Spearman's rho	1	-.348(**)
	Sig. (2-tailed)		.002
	N	76	76
Reading difficulty	Spearman's rho	-.348(**)	1
	Sig. (2-tailed)	.002	
	N	76	76

Table 29: Correlation between reading difficulty and children's overall voice quality in speech

		Reading difficulty	Voice quality in singing
Reading difficulty	Spearman's rho	1	-.160
	Sig. (2-tailed)		.168
	N	58	58
Voice quality in singing	Spearman's rho	-.160	1
	Sig. (2-tailed)	.168	
	N	58	58

Table 30: Correlation between reading difficulty and children's overall voice quality in singing

		Voice quality in speech	Behavioural difficulty
Voice quality in speech	Spearman's rho	1	-.005
	Sig. (2-tailed)		.971
	N	58	58
Behavioural difficulty	Spearman's rho	-.005	1
	Sig. (2-tailed)	.971	
	N	58	58

Table 31: Correlation between behavioural difficulty and children's overall voice quality in speech

		Behavioural difficulty	Voice quality in singing
Behavioural difficulty	Spearman's rho	1	.074
	Sig. (2-tailed)		.580
	N	58	58
Voice quality in singing	Spearman's rho	.074	1
	Sig. (2-tailed)	.580	
	N	58	58

Table 32: Correlation between behavioural difficulty and children's overall voice quality in singing

		speech	Sibling number
speech	Spearman's rho	1	.328(*)
	Sig. (2-tailed)		.012
	N	76	58
Sibling number	Spearman's rho	.328(*)	1
	Sig. (2-tailed)	.012	
	N	58	58

Table 33: Correlation between number of siblings and children's overall voice quality in speech

		Sibling number	singing
Sibling number	Spearman's rho	1	.156
	Sig. (2-tailed)		.241
	N	58	58
singing	Spearman's rho	.156	1
	Sig. (2-tailed)	.241	
	N	58	58

Table 34: Correlation between number of siblings and children's overall voice quality in singing

		Speech order	siblings
speech	Spearman's rho	1	.066
	Sig. (2-tailed)		.622
	N	58	58
Siblings order	Spearman's rho	.066	1
	Sig. (2-tailed)	.622	
	N	58	58

Table 35: Correlation between sibling order and children's overall voice quality in speech

		speech	Sibling order
singing	Spearman's rho	1	.054
	Sig. (2-tailed)		.542
	N	58	58
Siblings order	Spearman's rho	.054	1
	Sig. (2-tailed)	.543	
	N	58	58

Table 36: Correlation between sibling order and children's overall voice quality in singing

		Voice quality in speech	Gender
Voice quality in speech	Spearman's rho	1	-.009
	Sig. (2-tailed)		.942
	N	76	76
Gender	Spearman's rho	-.009	1
	Sig. (2-tailed)	.942	
	N	76	76

Table 37: Correlation between gender and children's overall voice quality in speech

		Gender	Voice quality in singing
Gender	Spearman's rho	1	.018
	Sig. (2-tailed)		.876
	N	76	76
Voice quality in singing	Spearman's rho	.018	1
	Sig. (2-tailed)	.876	
	N	76	76

Table 38: Correlation between gender and children's overall voice quality in singing

		Voice quality in speech	Age
Voice quality in speech	Spearman's rho	1	.176
	Sig. (2-tailed)		.129
	N	76	76
Age	Spearman's rho	.176	1
	Sig. (2-tailed)	.129	
	N	76	76

Table 39: Correlation between age and children's overall voice quality in speech

		Age	Voice quality in singing
Age	Spearman's rho	1	.379(**)
	Sig. (2-tailed)		.001
	N	76	76
Voice quality in singing	Spearman's rho	.379(**)	1
	Sig. (2-tailed)	.001	
	N	76	76

Table 40: Correlation between age and children's overall voice quality in singing

Appendix 2: First Study

2.1 Introduction

Four different groups of children formed the participant population and, therefore, each group was treated as a separate study. The first study was from a primary school in London (autumn, 2005); the second study was from the same school in the following school year (autumn, 2006); the third study was from a primary school in Finland (10-year-olds, autumn, 2006); and the fourth study was from the same school in Finland with a different age-group (7-year-olds, autumn, 2006). The focus for this chapter is data from the first study (London, 2005).

Statistical analyses were carried out in order to investigate:

a) voice qualities in speech and singing for individual children;

b) within and between group comparisons in terms of any similarities and differences between voice qualities in speech and singing for the 'Singing' and the 'Non-singing' Groups in study one;

c) intra-and inter-group comparisons, as well as analysis within the whole class, between specific voice parameters in speech and in singing;

d) the relationship between perceived speaking and singing competency and voice quality for individual children;

e) the impact of possible psychological factors on children's voice quality (and vice versa); as well as the psychological impact of singing on children;

f) the relationship between sociological factors and children's voice quality and vocal functioning in both speech and singing.

2.2 Information on participants

The participants for the first study (London, 2005) consisted of 22 children in one school in inner London. Of the original 25 participants, full data was available for 22 since 3 children were absent for parts of the data collection and so were not included in the final analyses. All 22 children were assessed on the specially designed singing and speaking protocols (see Chapter Five for details).

Based on the participants' previous experiences of singing, the class was divided into two groups: the 'Singing Group' and the 'Non-singing Group'. The children in the group clarified as the Singing Group had taken part in a music project over a period of three months in the previous school year (six months before the research assessment). In the project, the children were required to sing for at least four hours per week, as well as to play musical instruments of their choice. The children who had not participated in the music project had joined their peers at the beginning of the current school year to form a new class. The former group had been in the same school the year before, but they had been in a different class since the school operated on a one-and-half-year policy.

There were 13 individuals in the Singing Group and 9 in the Non-singing Group (see Table 1.1). The numbers in each group and their relative sizes to each other were taken into account in the selection process of appropriate non-parametric statistical measures (see footnote 1).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	singing	13	59.1	59.1	59.1
	non-singing	9	40.9	40.9	100.0
	Total	22	100.0	100.0	

Table 2.1: Participants in the Singing Group and the Non-singing Group

2.3 Voice quality scores

Each individual was rated by the three judges on fifteen sub-categories in speech and fifteen in singing. Thirteen of the categories concerned voice quality and the remaining two general vocal functioning (i.e. register and habitual pitch). Following an analysis of inter-judge reliability (see footnote 2), these individual scores were averaged across judges for each item. Then means were calculated separately for overall speech and overall singing. The scoring was undertaken using a seven-point scale in which one indicated 'healthy' voice quality and seven indicated 'extremely unhealthy' voice quality. This procedure was followed in all four empirical studies, two in the UK and two in Finland.

---

1) Non-parametric analyses were used since the participant population was relatively small and, therefore, one could not assume a normal distribution for the ratings (Robson, 2000).
2) Inter-judge reliability was calculated for both speech (w=0.183; p>0.05, n.s.) and singing (w=0.100; p>0.05, n.s.). The tests were not significant, indicating that the judges did not differ significantly in their ratings. Such a finding provides evidence that it was appropriate to use the means of the ratings provide by the three judges.

2.4 Overall voice quality in speech and overall voice quality in singing

The descriptive statistics demonstrated that there was difference between the overall voice quality ratings in speech and the overall voice quality ratings in singing when comparing all the participants as a group (see Table 2.2 and Figure 2.1) (see footnote 3). The mean rating for speech was 4.10 compared with 3.95 for singing. The standard deviation was slightly greater for singing than for speech (0.57 versus 0.54). The range of the ratings varied by 2.0 points for speech (2.9-4.9) and by 1.7 for singing (3.2-4.9).

Group	Speech			Singing		
	Mean	**Standard Deviation**	**Range**	**Mean**	**Standard Deviation**	**Range**
Whole class (n=22)	4.10	0.54	2.00	3.95	0.57	1.70
Non-singing Group (n=9)	4.18	0.49	1.50	4.04	0.60	1.60
Singing Group (n=13)	3.99	0.62	2.00	3.83	0.51	1.40

Table 2.2: Descriptive statistics for voice quality scores in speech and in singing where 1=healthy, 2=healthy, 3=healthy, 4=less healthy, 5=less healthy, 6=unhealthy, 7=extremely unhealthy (colours indicate three broad categories of vocal healthy, evidence of some vocal problem, or more extreme unhealthy voice use)

Neither type of vocal behaviour was highly rated on either end of the scale in terms of perceived vocal health, with each tending towards a mid point in the seven-point scale. However, for the class as a whole, singing behaviour was perceived as healthier than speaking. Nevertheless, overall voice quality in speech and overall voice quality in singing were statistically significantly similar to each other ($r=0.590$, $p<0.05$; see Table 2.3).

3) Means of the ratings were regarded as an appropriate tool in comparing the overall quality of the children's voices in speech to the overall quality of their voices in singing. The means were a collapsed score of the ratings provided for each voice parameter as indicated in the assessment protocol and, therefore, the means represented the general perceived impression on the quality of the children's voice.

			overall singing	overall speaking
Spearman's rho	overall singing	Correlation Coefficient	1.000	.589(**)
		Sig. (2-tailed)	.	.004
		N	22	22
	overall speaking	Correlation Coefficient	.589(**)	1.000
		Sig. (2-tailed)	.004	.
		N	22	22

Table 2.3: Correlation for rating for perceived overall voice quality in speech and in singing for the whole group of participants

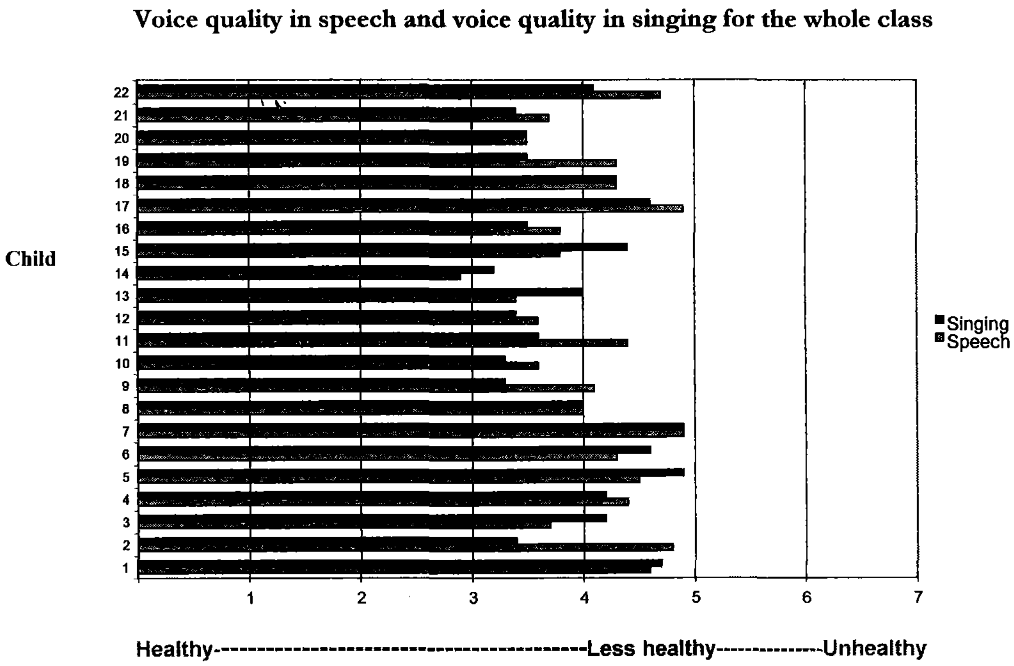


Figure 2.1: Bar chart for overall voice quality scores in speech and in singing for the individual participants in the class

In comparing the two groups of participants, there was not significant difference in vocal health rating for speech between the Non-singing Group and the Singing Group (3.99 versus 4.18, r=-328, n.s) (see Tables 2.5). Similarly, the same outcome was found in the data for overall voice quality in singing (3.83 versus 4.04; r=-0.239, n.s.) (see Table 2.6). For speech, the ratings varied by 1.5 points for the Singing Group (s.d. 0.49) and by 2.0 for Non-singing Group (s.d. 0.62). For singing, the ratings varied by 1.6 (s.d. 0.60) for the Singing Group and by 1.4 (s.d. 0.51) for the Non-singing Group. For the Singing Group, there was no significant difference between voice quality ratings in speech and in singing (r=515, n.s.) (see Table 2.7). However, for the Non-singing Group, the difference was statistically significant ($r=0.761$, $p<0.05$) (see Table 2.9), with speaking rated as slightly less healthy.

			speech quality non singing group	speech quality in singing group
Spearman's rho	speech quality non singing group	Correlation Coefficient	1.000	-.328
		Sig. (2-tailed)	.	.389
		N	9	9
	speech quality in singing group	Correlation Coefficient	-.328	1.000
		Sig. (2-tailed)	.389	.
		N	9	13

Table 2.5: Spearman's Correlation for overall voice quality ratings in speech between the Singing Group and the Non-singing Group

			singing quality non singing group	singing quality in singing group
Spearman's rho	singing quality non singing group	Correlation Coefficient	1.000	-.239
		Sig. (2-tailed)	.	.535
		N	9	9
	singing quality in singing group	Correlation Coefficient	-.239	1.000
		Sig. (2-tailed)	.535	.
		N	9	13

Table 2.6: Spearman's Correlation for overall voice quality ratings in singing between the Singing Group and the Non-singing Group

group				overall singing	overall speaking
Singing			N	13	13
	Spearman's rho	overall singing	Correlation Coefficient	1.000	.515
			Sig. (2-tailed)	.	.072
			N	13	13
		overall speaking	Correlation Coefficient	.515	1.000
			Sig. (2-tailed)	.072	.
			N	13	13
Non-singing	Spearman's rho	overall singing	Correlation Coefficient	1.000	.761(*)
			Sig. (2-tailed)	.	.017
			N	10	10
		overall speaking	Correlation Coefficient	.761(*)	1.000
			Sig. (2-tailed)	.017	.
			N	10	10

Table 2.7: Spearman's Correlation for overall voice quality ratings in speech and overall voice quality ratings in singing for the Singing Group and the Non-singing Group

When the overall voice quality ratings were rank-ordered for speech and for singing with the participants as a group, there were differences in their distribution (see Figure 2.2). For speech, the distribution was negatively skewed (skewness distribution: -0.288), suggesting that there was a greater a number of ratings above the mean. This indicates that there were a greater number of individuals possessing less healthy voice quality in speech than there were individuals possessing healthy voice quality in speech. For singing, the distribution was positively distributed (skewness distribution: 0.282), with a greater number of ratings lying below the mean and in the range of relatively healthy voice quality. The scatterplot below (see Figure 2.3) illustrates the relationship between voice quality ratings in speech and voice quality ratings in singing for the whole class.

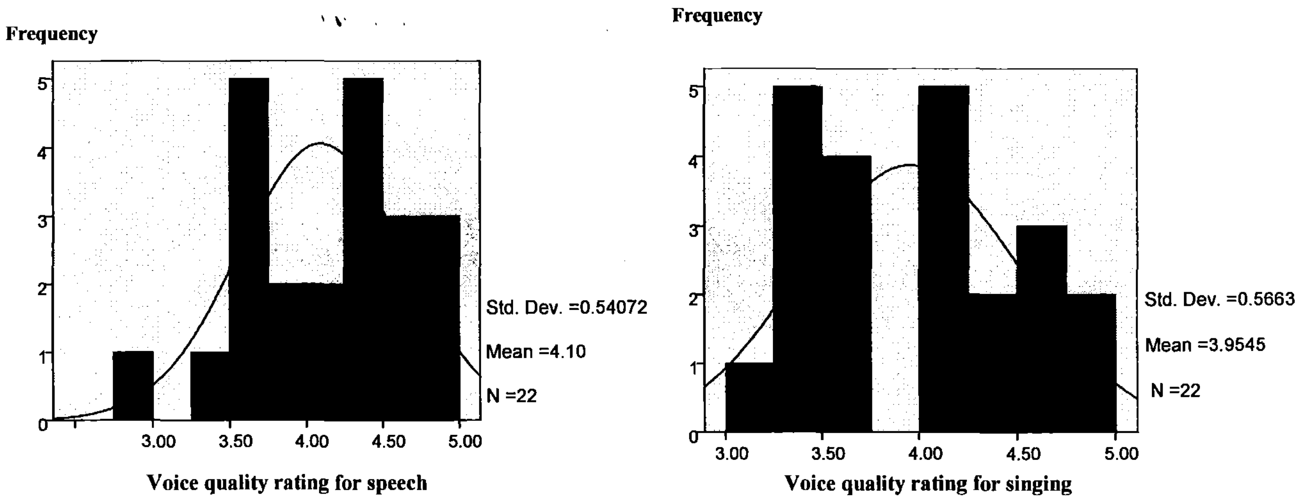


Figure 2.2: Distribution of rank-ordered voice quality ratings in speech (left figure) and in singing (right figure) for the whole class

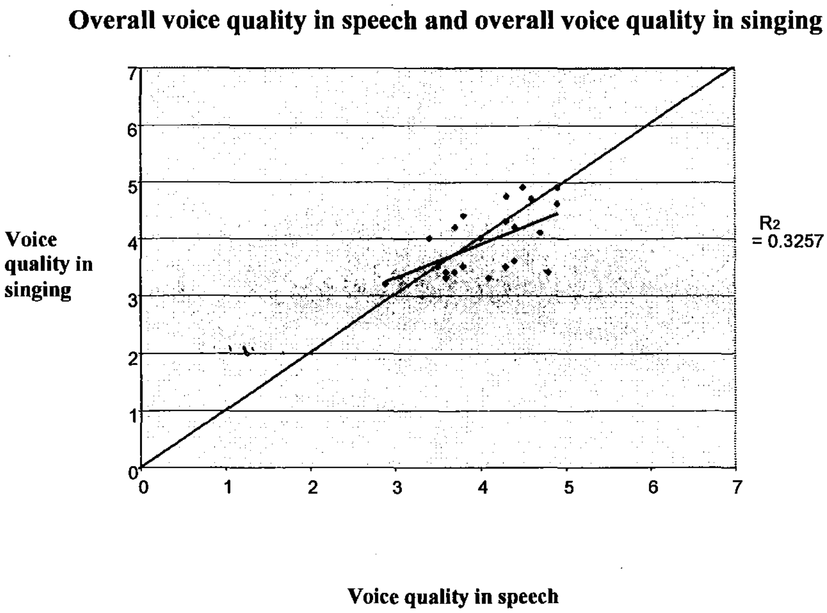


Figure 2.3: Relationship between mean voice quality scores in speech and those in singing for the whole class

The plot indicates a weak positive relationship ($r=0.589$; $p<0.05$) (see Table 2.3). This verifies the finding in the other non-parametric tests of the tendency for quality in one vocal behaviour to be associated with similar quality in the other. The plot also illustrates that there were no obvious outliers within the voice quality ratings. The correlations between individual voice parameters in speech and the same ones in singing supported such findings (see Table 2.8).

Child (sg=singing group; n=non singig group)	voicebeh	N	Mean Rank	Sum of Ranks	Mann Whitney U/Exact.Sig.
sg1	1.00	13	11.62	151.00	-1.297; .223
	2.00	13	15.38	200.00	
	Total	26			
sg2	1.00	13	11.85	154.00	-1.185; .287
	2.00	13	15.15	197.00	
	Total	26			
sg3	1.00	13	14.23	185.00	-.500; .650
	2.00	13	12.77	166.00	
	Total	26			
sg4	1.00	13	13.31	173.00	-.132; .920
	2.00	13	13.69	178.00	
	Total	26			
sg5	1.00	13	12.77	166.00	-.514; .650
	2.00	13	14.23	185.00	
	Total	26			
sg6	1.00	13	13.08	170.00	-.295; .801
	2.00	13	13.92	181.00	
	Total	26			
sg7	1.00	13	11.04	143.50	-1.730; .101
	2.00	13	15.96	207.50	
	Total	26			
sg8	1.00	13	13.38	174.00	-.079; .960
	2.00	13	13.62	177.00	
	Total	26			
sg9	1.00	13	11.69	152.00	-1.238; .243
	2.00	13	15.31	199.00	
	Total	26			
sg10	1.00	13	10.85	141.00	-1.807; .081
	2.00	13	16.15	210.00	
	Total	26			
sg11	1.00	13	9.73	126.50	-2.590; 0.010
	2.00	13	17.27	224.50	
	Total	26			

sg12	1.00	13	12.23	159.00	-.867; .418
	2.00	13	14.77	192.00	
	Total	26			
sg13	1.00	13	13.46	175.00	-.919; 1.000
	2.00	13	13.54	176.00	
	Total	26			
n1	1.00	13	12.92	168.00	-.37; .724
	2.00	13	14.08	183.00	
	Total	26			
n2	1.00	13	15.81	205.50	-1.611; .125
	2.00	13	11.19	145.50	
	Total	26			
n3	1.00	13	14.85	193.00	-.919; .390
	2.00	13	12.15	158.00	
	Total	26			
n4	1.00	13	13.04	169.50	-448; .762
	2.00	13	13.96	181.50	
	Total	26			
n5	1.00	13	12.77	166.00	-507; .650
	2.00	13	14.23	185.00	
	Total	26			
n6	1.00	13	13.08	170.00	-.292; .801
	2.00	13	13.92	181.00	
	Total	26			
n7	1.00	13	13.31	173.00	-.132; .920
	2.00	13	13.69	178.00	
	Total	26			
n8	1.00	13	14.46	188.00	-.656; .545
	2.00	13	12.54	163.00	
	Total	26			
n9	1.00	13	15.08	196.00	-1.12-; .311
	2.00	13	11.92	155.00	
	Total	26			

Table 2.8: Relationship between voice quality in speech and voice quality in singing for each child

The mode, median and standard deviations were calculated for each individual voice parameter in speech and in singing (see Table 2.9). In addition to the mean, the other central tendency measures were used in the analyses in order to investigate whether the same results were found via the use of these central tendency measures as those found via using the means of the ratings.

	N	Speech= mode	Singing= mode	Speech=Std. Deviation	Singing=Std. Deviation	Speech= median	Singing=median
ɔarseness	22	4.00	5.00	1.10978	1.43925	4.00	5.0
·eathiness	22	4.00	3.00	1.22032	1.29267	4.00	4.00
/perfunctional	22	4.00	3.00	1.33550	1.62302	4.00	3.00
/pofunctional	22	3.00	1.00	.98473	1.06600	3.00	1.00
·atings	22	2.00	2.00	1.21677	1.73829	2.50	3.50
ıugh	22	3.00	6.00	1.39650	1.81623	2.00	4.00
·eaks	22	3.00	1.00	1.05375	1.25874	2.00	2.00
ıstable	22	1.00	2.00	.92113	1.29601	2.00	2.00
ard	22	2.00	2.00	1.05375	1.52114	2.00	2.00
ɔcal fry	22	2.00	6.00	1.48950	1.72892	2.00	4.50
ɹdible	22	2.00	2.00	1.09801	1.09801	2.00	2.00
ypernasal	22	3.00	2.00	.90692	1.54863	5.00	2.00
yponasal	22	2.00	1.00	.81650	1.09801	3.00	1.0
alid N (listwise)	22						

Table 2.9: Descriptive statistics for separate voice parameters in speech and in singing

The finding was that the correlation between each measure in speech and that in singing was statistically significant (mode: r=0.587; p<0.05; median: r=0.851; p<0.05; standard deviation: r=0.617; p<0.05) (see Figure 2.4 below and Tables 2.10-2.12). The correlations were positive and fairly strong (see Figure 2.4).

			modsp	modsing
Spearman's rho	modsp	Correlation Coefficient	1.000	.587(*)
		Sig. (2-tailed)	.	.022
		N	15	15
	modsing	Correlation Coefficient	.587(*)	1.000
		Sig. (2-tailed)	.022	.
		N	15	15

Table 2.10: Relationship between mode for voice quality in speech and mode for voice quality in singing

			medsp	medsin
Spearman's rho	medsp	Correlation Coefficient	1.000	.851(**)
		Sig. (2-tailed)	.	.000
		N	15	15
	medsin	Correlation Coefficient	.851(**)	1.000
		Sig. (2-tailed)	.000	.
		N	15	15

Table 2.11: Relationship between median for voice quality in speech and median for voice quality in singing

			stsinging	stspeech
Spearman's rho	stsinging	Correlation Coefficient	1.000	.617(*)
		Sig. (2-tailed)	.	.025
		N	13	13
	stspeech	Correlation Coefficient	.617(*)	1.000
		Sig. (2-tailed)	.025	.
		N	13	13

Table 2.12: Relationship between standard deviation for voice quality in speech and standard deviation for voice quality in singing

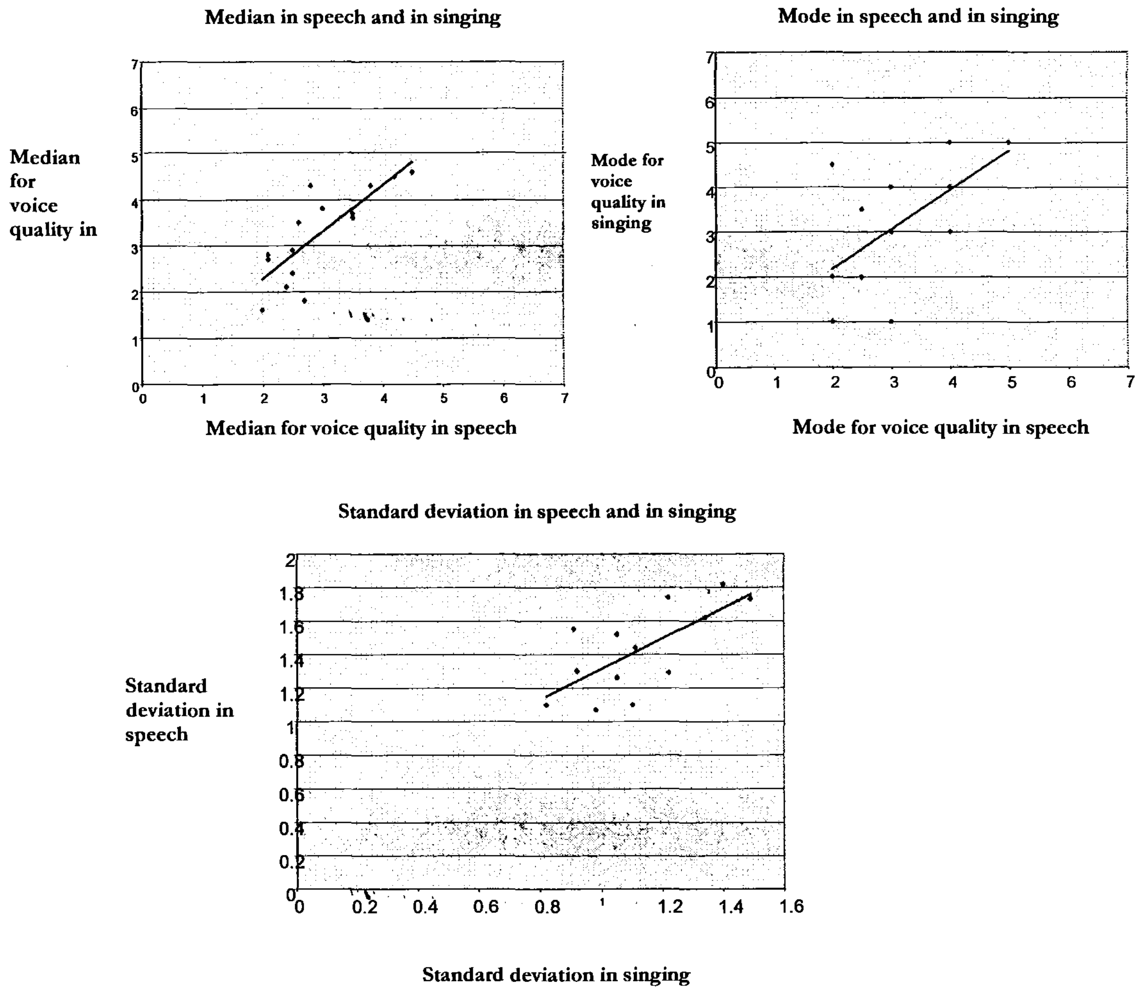


Figure 2.4: Scatterlpots for: median for voice quality in speech and voice quality in singing for the whole class (left figure on top corner); mode for voice quality in speech and voice quality in singing for the whole class (right figure top right corner); and standard deviation in speech and in singing (figure below)

The boxplots below illustrate the distribution of voice quality ratings in speech and in singing for the Singing and the Non-singing Groups (see Figure 2.5). The distribution was symmetrical in speech for the Singing Group, indicating that there were an equal number of voice quality ratings on both sides of the median. However, the distribution for speech is positively skewed for the Non-singing Group, indicating that there were a greater number of negative voice quality ratings above the median than below it, implying that there were a greater number of individuals possessing less healthy voice quality in speech than there are those possessing healthy voice quality.

The distribution for singing was negatively skewed for the Singing Group, indicating that there was a greater number of voice quality ratings below the median than there were above it (see Figure 2.5). Thus, there were a greater number of individuals with healthier voice quality in singing than there were with unhealthier voice quality. However, the distribution was positively skewed for the Non-singing Group, indicating that there were a greater number of voice quality ratings above the median than below it. Therefore, there were a greater number of individuals with unhealthy compared to healthy voice quality in singing.

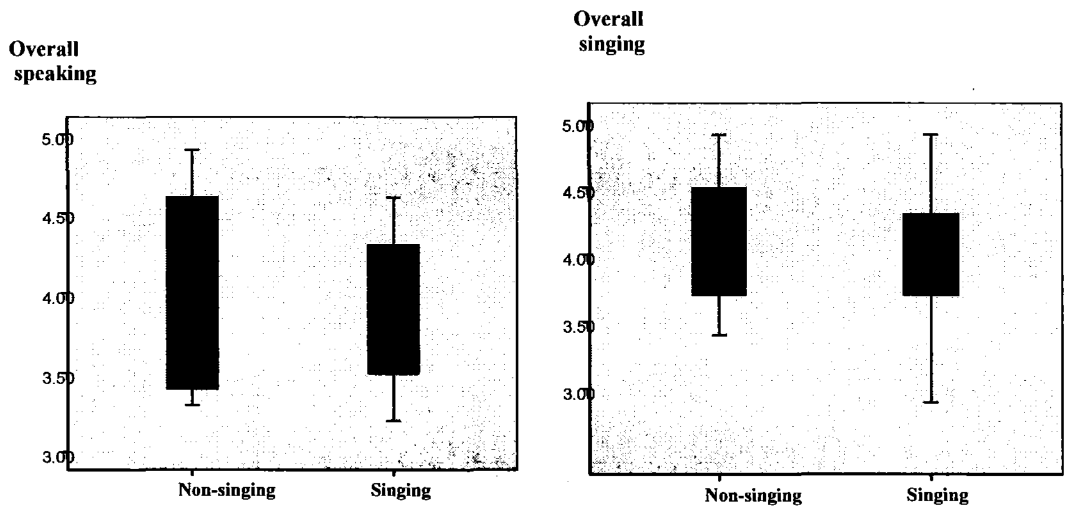


Figure 2.5: Boxplots for the distribution of overall voice quality ratings in speech (left figure) and in singing (right figure) for the Singing and the Non-singing Groups

There was greater variation amongst the ratings in the Singing Group than in the Non-singing Group, for both speech and singing. It may be that singing experience can have a positive effect on overall vocal functioning. This hypothesis from Study 1 needs to be explored in the other Studies.

2.5 Voice parameters in speech and singing

In addition to investigating the relationship between the mean ratings in speech and those in singing, non-parametric tests were calculated in order to investigate whether the same results were found when comparing the ratings for each voice parameter in speech to those in singing rather the mean scores for overall voice quality in both behaviours. The result was not significant (z=1.002, 1.091; n.s.) (see Table 2.13).

		overall speaking	overall singing
N		22	22
Uniform Parameters(a,b)	Minimum	2.90	3.20
	Maximum	4.90	4.90
Most Extreme Differences	Absolute	.214	.233
	Positive	.045	.233
	Negative	-.214	-.091
Kolmogorov-Smirnov Z		1.002	1.091
Asymp. Sig. (2-tailed)		.268	.185

Table 2.13: Kolmogorov-Smirnov non-parametric test for testing the relationship between voice quality in speech and voice quality in singing when taking all the separate voice parameters into consideration

The tests were not significant for the sub groups either (the 'Singing Group': z=0.884,0.499; n.s.; the 'Non-singing Group': z=0.567,1.024; n.s) (see Tables 2.14 and 2.15). The findings indicate that voice quality in speech did not differ significantly from voice quality in singing when taking the ratings for all the different voice parameters into consideration.

		singing quality in singing group	speech quality in singing group
N		13	13
Uniform Parameters(a,b)	Minimum	3.30	3.40
	Maximum	4.90	4.90
Most Extreme Differences	Absolute	.245	.138
	Positive	.245	.108
	Negative	-.154	-.138
Kolmogorov-Smirnov Z		.884	.499
Asymp. Sig. (2-tailed)		.415	.964

Table 2.14: Kolmogorov-Smirnov non-parametric test for testing the relationship between voice quality in speech and voice quality in singing for the 'Singing Group' when taking all the separate voice parameters into consideration

		speech quality non singing group	singing quality non singing group
N		9	9
Uniform Parameters(a,b)	Minimum	2.90	3.20
	Maximum	4.90	4.60
Most Extreme Differences	Absolute	.189	.341
	Positive	.111	.341
	Negative	-.189	-.119
Kolmogorov-Smirnov Z		.567	1.024
Asymp. Sig. (2-tailed)		.905	.245

Table 2.15: Kolmogorov-Smirnov non-parametric test for testing the relationship between voice quality in speech and voice quality in singing for the 'Non-singing Group' when taking all the separate voice parameters into consideration

Voice quality in speech was compared to voice quality in singing for each child separately when taking individual voice parameters into consideration as opposed to the means. For the majority of the children (n=21 out of 22), the results were not significant (see Table 2.8), suggesting that voice quality in speech did not differ significantly from that in singing. There was only one individual (individual 11) for whom the test was significant ($z=-2.590$; $p<0.05$). This child possessed healthier overall voice quality in singing than in speech (mean for singing: 4.40; mean for speech: 3.60).

2.6 General impressions and the detail of voice quality

On a 7-point scale, ratings from 5 to 7 were treated as unhealthy voice quality, whilst ratings from 1 to 3 were treated as healthy voice quality and the ratings from 4 to 5 as less healthy. The voice ratings clustered around 4.0 for both speech and singing, indicating that the majority of the children possessed slightly unhealthy voice quality. Therefore, in subsequent analysis, children with ratings between 5 and 7 were referred to as those possessing voice disorders.

It should be noted that the judges may not have been equally sensitive to all voice parameters, which may have biased the ratings. For example, hoarse and rough voice quality are the most common voice distortions amongst children (see Chapter Three). However, when looking through the ratings by the three judges, they seemed to have been consistent in their ratings and the inter-judge reliability was high (see Section 5.17 in Chapter Five).

2.7 Voice parameters and their impact on overall voice quality

The ratings for different voice parameters for individual children were looked at in more detail in order to investigate (i) whether there were specific voice parameters that seemed to be influencing the overall voice quality of the children's voice and (ii) whether the means were an appropriate tool in comparing the children's voice quality characteristics in speech to those in singing.

Hoarseness was perceived as the unhealthiest voice quality (that is, it had the highest ratings), whilst hyponasality was perceived as the healthiest voice quality in both speech and singing (see Tables 2.16 and 2.17). Roughness, breathiness and (in singing) vocal fry obtained a relatively high prevalence of unhealthy characteristics. Hypofunction and hyponasality were perceived as healthy in both speech and singing. However, there were no statistically significant differences between the distribution of the ratings for the 13 different parameters (Kruskal-Wallis: $z=0.446$; $p>0.05$, n.s.).

Voice parameter	Speech	Singing
Hoarse	50% less healthy; 36.4% unhealthy	45.5% less healthy; 27.3% unhealthy
Breathy	45.5% less healthy; 27.3% unhealthy	31.8% less healthy, 27.3% unhealthy
Vocal fry	36.4% less healthy, 31.8% unhealthy	36.4% less healthy; 36.4% unhealthy
Rough	13.6% less healthy; 45.5% unhealthy	31.8% less healthy, 22.7% unhealthy
Hyponasal	95.6% healthy	90.1% healthy
Hypofunctional	95.6% healthy	90.1% healthy

Table 2.16: Percentages for unhealthy and healthy voice quality characteristics in speech and in singing for those voice parameters that were rated as the healthiest and the unhealthiest ones

When the mean ratings for voice parameters in speech and in singing were rank-ordered, the differences between mean ratings in speech and mean ratings in singing became more evident (see Table 2.17). The biggest differences between the mean ratings in speech and those in singing were recorded in vocal fry (1.4 points higher in singing than in speech), hypofunction (0.7 points higher in speech than in singing) and gratings (0.9 points higher in singing than in speech). It should be noted that a greater number of voice parameters were rated as unhealthier in singing than in speech (see Table 2.17).

Voice parameter	Mean rating in speech	Mean rating in singing
Hoarse	4.3	4.5
Breathy	3.8	4.4
Hyperfunctional	3.5	3.6
Rough	3.0	3.8
Vocal fry	2.9	4.3
Hypofunctional	2.7	1.8
Gratings	2.6	3.5
Hard glottal attack	2.6	2.9
Audible inhalation	2.6	2.4
Voice breaks	2.4	2.2
Hypernasality	2.2	1.6
Unstable pitch/ quality	2.1	2.8
Hyponasality	2.0	1.4

Table 2.17: Rank-ordered mean ratings for voice parameters where 1=healthy, 2=healthy, 3=healthy, 4=less healthy, 5=less healthy, 6=unhealthy, 7=extremely unhealthy (colours indicate three broad categories of vocal healthy, evidence of some vocal problem, or more extreme unhealthy voice use)

The radar-charts below (see Figure 2.6) verify the findings from the Tables above. They illustrate the voice parameters rated the healthiest and those rated the unhealthiest. The mean ratings for the voice parameters were used as means to a measure and represent the data.

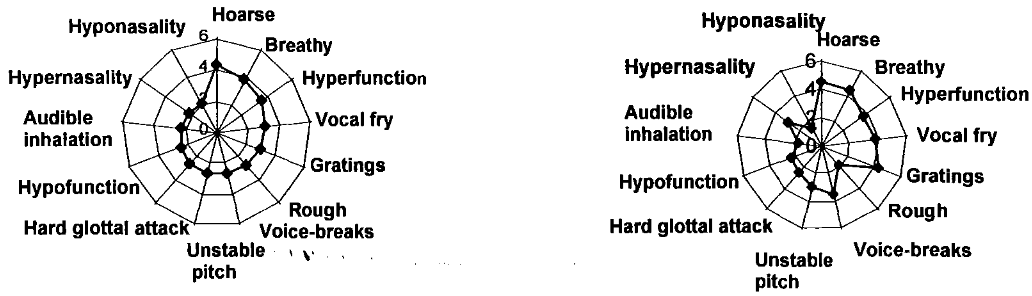


Figure 2.6: Radar-charts for mean ratings in speech (left figure) and mean ratings in singing (right figure) for the whole class

The figures for the 'Singing Group' and the Non-singing Group' supported the above findings. The radar-charts below illustrate the findings for 'the Singing Group' (see Figure 2.7). Hoarse, breathy, hyperfuntional and rough voice qualities were rated as the unhealthiest ones in speech, whilst unstable pitch and hyponasality were rated the healthiest ones in speech. In singing, hoarse and vocal fry qualities were rated the unhealthiest. Hyponasality and hypofunctioning were rated the healthiest ones.

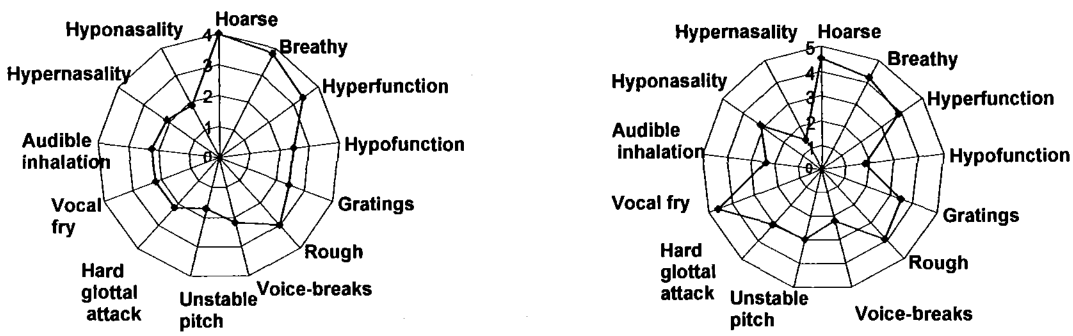


Figure 2.7: Radar-charts for mean ratings in speech and mean ratings in singing for the 'Singing Group'

The radar-charts below illustrate the findings for 'the Non-singing Group' (see Figure 2.8). Hoarse, breathy and hyperfunctional qualities were rated as the unhealthiest and hyponasality was rated as the healthiest in speech. In singing, hoarse, breathy and vocal fry qualities were rated as the unhealthiest, whilst hyponasality and hypernasality were rated as the healthiest.

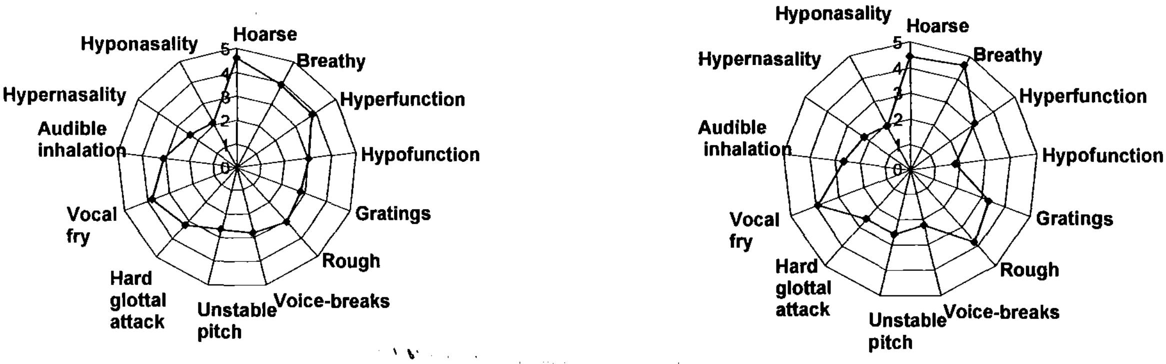


Figure 2.8: Radar-charts for mean ratings in speech and mean ratings in singing for the 'Non-singing Group'

2.8 Individual differences

General trends were noted in the class of children in terms of unhealthiest and healthiest voice qualities. Such characteristics were looked at in more detail in both speech and singing.

2.8.1 Unhealthy characteristics

When looking at the distribution of ratings for each individual child in terms of voice quality in speech (see Table 2.18 and Figure 2.9 below), hoarseness was rated as the unhealthiest for 72.7% of the children. Therefore, the rating for this particular parameter influenced the mean rating of overall voice quality for these children. Roughness (for 59.1% of the children), breathiness (for 49.5% of the children) and hyperfunction (for 49.5% of the children) biased the mean ratings towards unhealthier overall voice quality for approximately half the children.

When looking at the distribution of the ratings in singing (see Figure 2.9 and Table 13 in the Appendix 1), hoarseness was rated as the unhealthiest one for 54.5% of the children. Therefore, the rating for this particular parameter influenced the mean rating of overall voice quality for these children. Roughness (for 45.5% of the children), vocal fry (for 45.5% of the children) and breathiness (for 40.9% of the children) were also rated as unhealthy, biasing the mean ratings of overall voice quality towards unhealthier voice quality for nearly half the children.

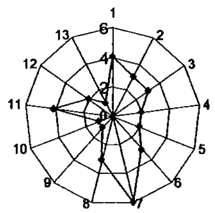
2.9.2 Healthy characteristics

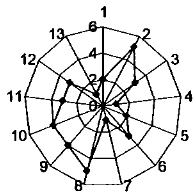
When looking at the distribution of ratings in speech (see Figure 2.13 and Table 2.18 below), hypofunction and hyponasality were rated as the healthiest voice qualities for 95.5 percent of the children. The finding was the same in singing. Voice-breaks were also rated as healthy for 90.9 percent of the children in speech and 86.4 per cent of the children in singing.

It should be noted that a great number of the mean voice quality ratings fell between the range of 1.0 and 3.0 for each individual voice parameter, indicating healthy overall voice quality. A significant number also fell between 4.0 and 5.0, with relatively few ratings falling above 5.0. This indicates that the unhealthiest and the healthiest voice parameters indicated above contributed towards the overall voice quality of the children's voices fairly significantly and had an impact on the listener's general impression of the individual children's voices.

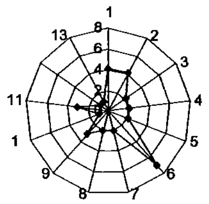
Figure 2.9: Radar-charts for individual children. In all the figures, the following numbering on the outer circle was used to represent the voice parameters: 1= hoarse, 2=breathy, 3=hyperfunction, 4=hypofunction, 5=gratings, 6=rough, 7=voice-breaks, 8=unstable pitch, 9=hard glottal attack, 10= vocal fry, 11=audible inhalation, 12=hypernasality, 13=hyponasality. The numbering on the inner line was used to represent the scale of the voice ratings. The rating scale consisted of: 1-3= healthy voice quality; 4-5= less healthy voice quality; 6-7= unhealthy voice quality.

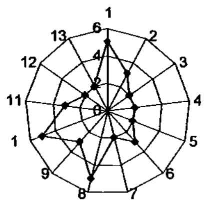
Individual 1: speech (left figure) and singing (right figure)



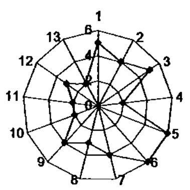


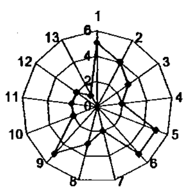
Individual 2: speech (left figure) and singing (right figure)



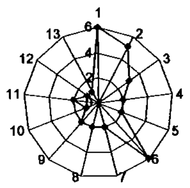


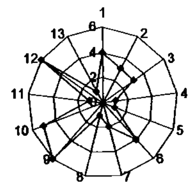
Individual 3: speech (left figure) and singing (right figure)



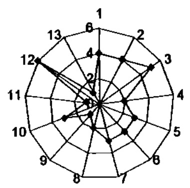


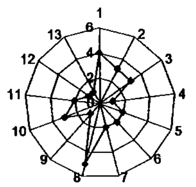
Individual 4: speech (left figure) and singing (right figure)



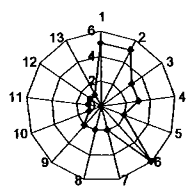


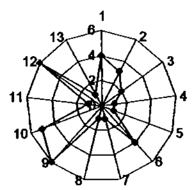
Individual 5: speech (left figure) and singing (right figure)



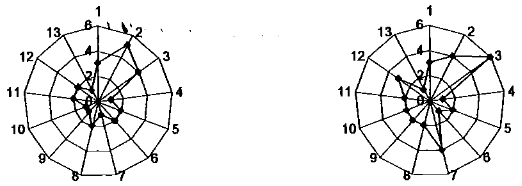


Individual 6: speech (left figure) and singing (right figure)

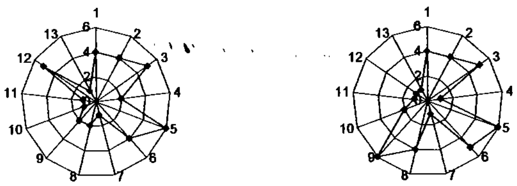




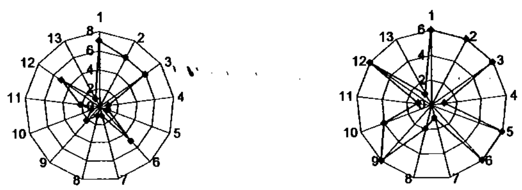
Individual 7: speech (left figure) and singing (right figure)



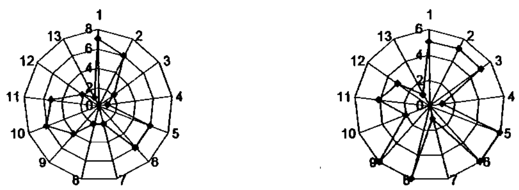
Individual 8: speech (left figure) and singing (right figure)



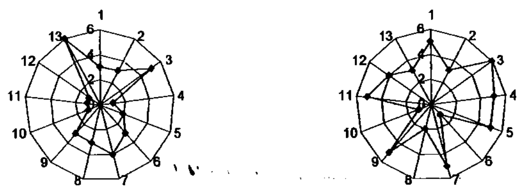
Individual 9: speech (left figure) and singing (right figure)



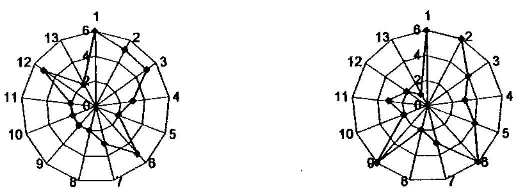
Individual 10: speech (left figure) and singing (right figure)



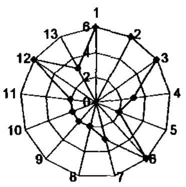
Individual 11: speech (left figure) and singing (right figure)

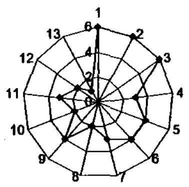


Individual 12: speech (left figure) and singing (right figure)

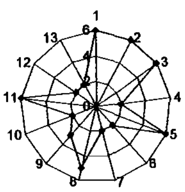


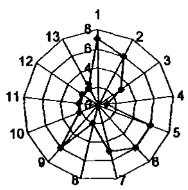
Individual 13: speech (left figure) and singing (right figure)



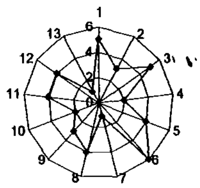


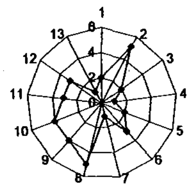
Individual 14: speech (left figure) and singing (right figure)



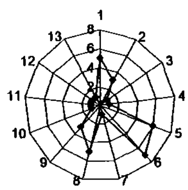


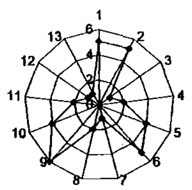
Individual 15: speech (left figure) and singing (right figure)



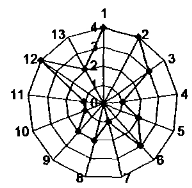


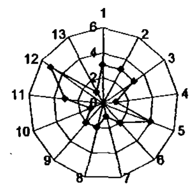
Individual 16: speech (left figure) and singing (right figure)



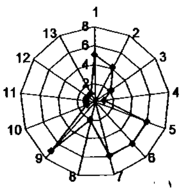


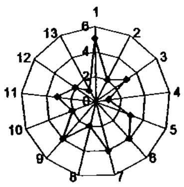
Individual 17: speech (left figure) and singing (right figure)



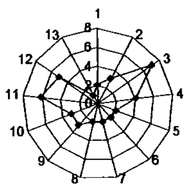


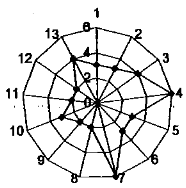
Individual 18: speech (left figure) and singing (right figure)



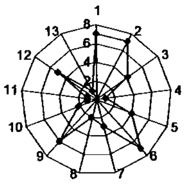


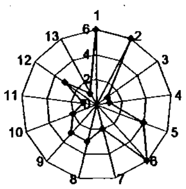
Individual 19: speech (left figure) and singing (right figure)



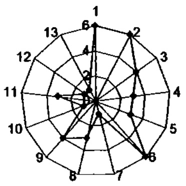


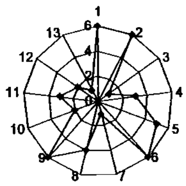
Individual 20: speech (left figure) and singing (right figure)



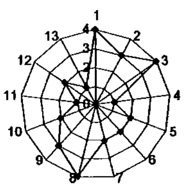


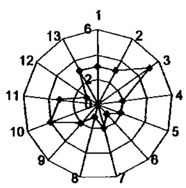
Individual 21: speech (left figure) and singing (right figure)





Individual 22: speech (left figure) and singing (right figure)





Voice parameter in speech	Rated as healthy voice quality	Rated as less healthy voice quality	Rated as unhealthy voice quality
Hoarse	8, 11, 9	1,2,5, 7, 15,16, 17, 18, 22	3,4,6,9,10,12,13,14,20
breathy	1,4,5,8,11,15,16,19,22	2,3,6,7,10,15,16	9,10,13,14,20,21
hyperfucntional	1,2,4,6,7,10,16,17,18	3,5,8,11,12,15,20,21,22	9,13,14,19
hypofunctional	1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15,16,17,18,20,21,22	19	
gratings	1,2,4,5,6,7,9,11,12,13,17,19, 21,22	3,11,12,13,16,21	3,8,10,14,16,18
rough	1,5,7,11,14,17,19,22		6,9,10,12,13,15,16,18, 20,21
voice breaks	2,3,4,5,6,7,8,9,11,12,13,14, 15,16,17, 18,19,20,21,22	11	1,18
unstable pitch	1,2,3,4,5,6,7,8,9,11,12,13, 14,15,16,17,18,19,20,21,22		
hard glottal attack	2,3,6,7,8,9,11,12, 14,15,16,17,18,19,20,21,22	1,4,5,10,13	
vocal fry	1,4,5,6,7,14,19,22	2,8,9,11,12,13,15,16,20	3,10,17,18,21
audible inhalation	2,3,4,5,6,7,8,9,11,12,13,16,17,18, 20,21,22	1,10,15	14,19
hypernasality	1,2,3,4,6,7,10,11,14,15,16	8,9,19,20	5,13
hyponasality	1,2,3,4,5,6,7,8,9,10,12,13,14,15, 16,17,18,19,20,21,22		11
Voice parameter in singing	**Rated as healthy voice quality**	**Rated as less healthy voice quality**	**Rated as unhealthy voice quality**
hoarse	1,7,15,19,22	4,5,6,8,10,11,16,17,18	2,3,9,12,13,1,4,20,21
breathy	2,4,5,6,11,17,18,19,22	1,3,7,8,10,15,16	9,12,13,14,20,21
hyperfunctional	1,2,3,4,5,6,7,15,16,20,21	9,11,13,18,20,22	8,10,12,14
hypofunctional	1,2,3,4,5,6,7,8,9,10,12,13,14,15,16, 17,18,19,20,21,22		11

gratings	1,2,3,4,5,6,7,15,17,18,19,20,22	3,11,12,13,16,21	8,9,10,14
rough	1,2,5,7,11,15,1718,19,20	3,4,6,8,13,16	9,10,12,14,20,21
voice breaks	1,2,3,4,5,6,7,8,9,10,12,13,15,16,17, 18,19,20,21,22		11,14
unstable pitch	3,5,7,8,10,11, 12,13,14,17,18,19, 20,21	1,2,4,6,9,15,16,22	
hard glottal attack	3,5,7,8,10,11, 12,13,14,17,18,19, 20,22	1,2,4,6,9,15,16,21	
vocal fry	2,5,7,17,19,20,22	1,3,11,13,15,18	4,6,8,9,10,12,14,16,21
audible inhalation	1,2,3,4,5,6,7,8,9,12,13,14,15,16,17, 18,20,21,22	10,11,19	
hypernasality	1,2,3,5,7,8,10,11,12,13,14,15,16,17, 18,20,21,22	19	4,6,9
hyponasality	1,2,3,4,5,6,7,8,9,10,12,13,14,15,16, 17,18,19,20,21,22		11

Table 2.18: Distribution of ratings for separate voice parameters for each individual in speech and in singing (number sin the boxes represent the identification numbers of each individual child)

2.9 Relationships between different voice parameters

Correlations between different voice parameters were calculated in order to investigate whether unhealthy voice quality in specific parameters was likely to correlate with unhealthy quality in any other parameters. Such correlations were calculated between each of the 13 parameters in speech and in singing, separately.

In speech, statistically significant correlations were found between hoarse and breathy voice quality ($r=0.664$, $p<0.01$); and hyperfunctioning and hypernasality ($r=0.775$, $p< 0.01$) (see Figure 2.10 below). The findings imply that there is a connection between the above voice qualities: when one has more hoarse voice quality in speech, one's voice is likely to be breathy too (and vice versa); when one's vocal functioning is hyperfunctional in speaking, one's voice is also likely to be hypernasal (and vice versa).

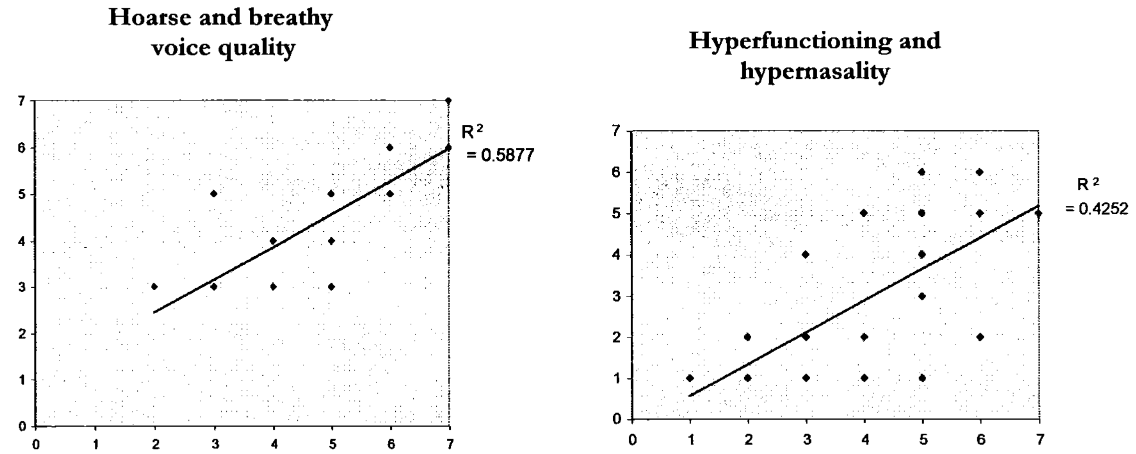
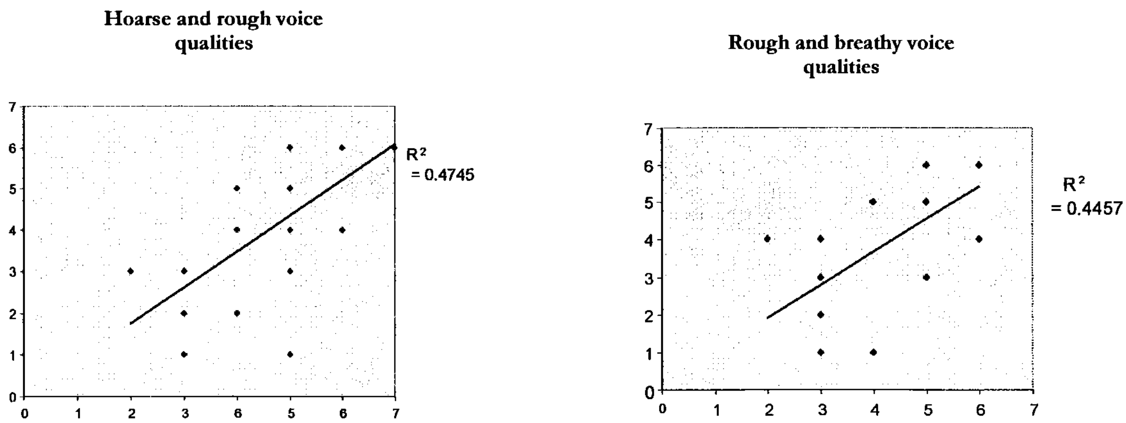


Figure 2.10: Scatterplots for hoarse and breathy voice qualities in speech (left Figure); and hyperfunction and hypernasality in speech (right Figure)

In singing, fairly significant correlations were found between: hoarse and rough voice quality; and rough and breathy voice quality (see Figure 2.11). However, the correlations were not statistically significant (hoarse and rough: r=316, n.s.; rough and breathy: r=0.182, n.s.). The correlation between hypofunctioning and hyponasality was statistically significant (r=0.795, $p<0.01$) (see Figure 2.11). The findings imply that there are connections between the above voice qualities. When one's voice is rough, it is also more likely to be hoarse and breathy; when one's vocal functioning is hypofunctional, one's voice is also more likely to be hyponasal.



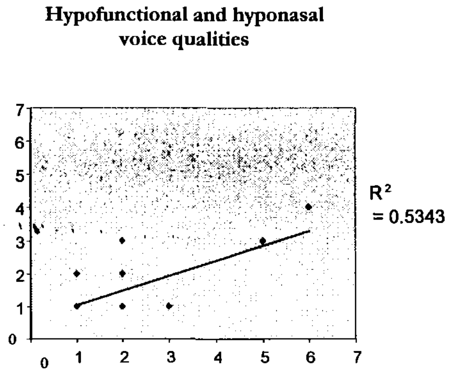


Figure 2.11: Correlation between hoarse and rough voice quality in singing (left top Figure); rough and breathy voice quality in singing (right top Figure); and hypofunction and hyponasality in singing (lower Figure)

2.10 Perceived speaking and singing competency

The children's speaking and singing competencies were assessed with the use of a specially-designed protocol (see Chapter Three and Appendix 1). The protocol consisted of a section for speech and a section for singing. The scale of the protocol ranged from 10 to 60 and it had been divided into six different categories, each being of 10 points in value (see Chapter Four and Appendix 1). Non-parametric correlations were used in the analyses in order to investigate whether the perceived levels of the children's speaking and singing competencies correlated with the quality of their voice.

The correlation was statistically significant between perceived singing competency and overall voice quality in speech ($r=-0.468$, $p< 0.05$) (see Table 2.19). The correlation was negative, indicating that the higher the level of a child's perceived singing competency was, the worse the overall quality of the child's voice in speech is. The scatterplot below demonstrates the finding in a graphic form (see Figure 2.12).

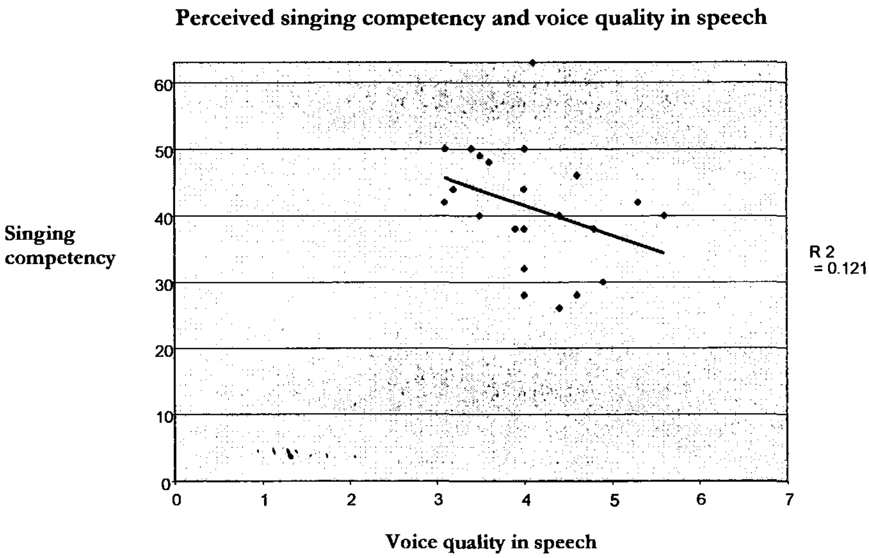


Figure 2.12: Relationship between perceived singing competency and overall voice quality in speech for the whole class

			overall speaking	singing competency
Spearman's rho	overall speaking	Correlation Coefficient	1.000	-.468(*)
		Sig. (2-tailed)	.	.028
		N	22	22
	singing competency	Correlation Coefficient	-.468(*)	1.000
		Sig. (2-tailed)	.028	.
		N	22	22

Table 2.19: Spearman Correlation between perceived singing competency and overall voice quality in speech for the whole class

The relationship between perceived singing competency and overall voice quality in speech was significant for the Singing Group (r=-0.595, p< 0.032) but not for the Non-singing Group (r=-0.361, n.s.) (see Table 2.20). This implies that the higher the level of a child's perceived singing competency is, the worse the overall quality of the child's voice in speech was. The non-parametric correlations between perceived speaking competency and voice quality in both speech and singing, as well as perceived singing competency and voice quality in singing, were not significant (see Tables 2.21-2.24).

group				overall speaking	singing competency
singing	Spearman's rho	overall speaking	Correlation Coefficient	1.000	-0.595
			Sig. (2-tailed)	.	.027
			N	13	13
		singing competency	Correlation Coefficient	.027	1.000
			Sig. (2-tailed)	-0.595	.
			N	13	13
non-singing	Spearman's rho	overall speaking	Correlation Coefficient	1.000	.361
			Sig. (2-tailed)	.	.352
			N	9	9
		singing competency	Correlation Coefficient	.361	1.000
			Sig. (2-tailed)	.352	.
			N	9	9

Table 2.20: Spearman Correlation between perceived singing competency and overall voice quality in speech for the Singing Group and the Non-singing Group

			overall speaking	speaking competency
Spearman's rho	overall speaking	Correlation Coefficient	1.000	.239
		Sig. (2-tailed)	.	.285
		N	22	22
	speaking competency	Correlation Coefficient	.239	1.000
		Sig. (2-tailed)	.285	.
		N	22	22

Table 2.21: Correlation between perceived speaking competency and overall voice quality in speech for the whole class

			overall singing	speaking competency
Spearman's rho	overall singing	Correlation Coefficient	1.000	.060
		Sig. (2-tailed)	.	.792
		N	22	22
	speaking competency	Correlation Coefficient	.060	1.000
		Sig. (2-tailed)	.792	.
		N	22	22

Table 2.22: Correlation for perceived speaking competency and overall voice quality in singing for the whole class

group				overall singing	speaking competency
singing	Spearman's rho	overall singing	Correlation Coefficient	1.000	-.053
			Sig. (2-tailed)	.	.864
			N	13	13
		speaking competency	Correlation Coefficient	-.053	1.000
			Sig. (2-tailed)	.864	.
			N	13	13
non-singing	Spearman's rho	overall singing	Correlation Coefficient	1.000	.392
			Sig. (2-tailed)	.	.297
			N	9	9
		speaking competency	Correlation Coefficient	.392	1.000
			Sig. (2-tailed)	.297	.
			N	9	9

Table 2.23: Correlation for perceived speaking competency and overall voice quality in singing for the Singing Group and the Non-singing Group

			overall singing	singing competency
Spearman's rho	overall singing	Correlation Coefficient	1.000	.349
		Sig. (2-tailed)	.	.435
		N	22	22
	singing competency	Correlation Coefficient	.349	1.000
		Sig. (2-tailed)	.435	.
		N	22	22

Table 2.24: Correlation between perceived singing competency and overall voice quality in singing for the whole class

Competency on the individual voice parameters was investigated in order to verify the above findings. The above finding that perceived singing competency had a significant effect on the overall quality of a child's voice in speech was contradicted when looking at its effect on separate voice parameters in speech. The results were not statistically significant for any of the 13 voice parameters (see Table 2.25). The effect of perceived speaking competency on the overall quality of a child's voice in speech when taking separate voice parameters in to consideration was not statistically significant either (see Table 2.26). The above findings suggest that neither singing competency nor speaking competency had a statistically significant effect on the overall quality of the children's voice in speech when taking individual voice parameters into consideration.

However, perceived singing competency had a statistically significant effect on the individual voice parameters in singing (see Tables 2.27-2.30). The effect was statistically significant on one specific voice parameter (hard glottal attack). The effect of perceived speaking competency on the overall quality of the children's voice in singing when taking individual voice parameters into consideration was statistically significant for two voice parameters (hyperfunctional and voice breaks). The findings suggest that the level of a child's speaking competency may have a significant effect on the overall quality of a child's voice singing.

			singing competency	overall singing
Spearman's rho	singing competency	Correlation Coefficient	1.000	-.357
		Sig. (2-tailed)	.	.103
		N	22	22
	overall singing	Correlation Coefficient	-.357	1.000
		Sig. (2-tailed)	.103	.
		N	22	22

Table 2.25: Correlation between perceived singing competency and overall voice quality in singing for the whole class

group				overall singing	singing competency
singing	Spearman's rho	overall singing	Correlation Coefficient	1.000	-.449
			Sig. (2-tailed)	.	.124
			N	13	13
		singing competency	Correlation Coefficient	-.449	1.000
			Sig. (2-tailed)	.124	.
			N	13	13
non-singing	Spearman's rho	overall singing	Correlation Coefficient	1.000	-.322
			Sig. (2-tailed)	.	.398
			N	9	9
		singing competency	Correlation Coefficient	-.322	1.000
			Sig. (2-tailed)	.398	.
			N	9	9

Table 2.26: Correlation for perceived singing competency and the overall quality of one's voice in singing for the Singing and the Non-singing Groups

		Sum of Squares	df	Mean Square	F	Sig.
speaking hoarseness	Between Groups	20.030	14	1.431	1.717	.241
	Within Groups	5.833	7	.833		
	Total	25.864	21			
speaking breathiness	Between Groups	19.439	14	1.389	.821	.644
	Within Groups	11.833	7	1.690		
	Total	31.273	21			
speaking hyperfunctional	Between Groups	32.455	14	2.318	3.245	.062
	Within Groups	5.000	7	.714		
	Total	37.455	21			
speaking hypofunctional	Between Groups	14.030	14	1.002	1.108	.469
	Within Groups	6.333	7	.905		
	Total	20.364	21			
speaking gratings	Between Groups	23.258	14	1.661	1.485	.308
	Within Groups	7.833	7	1.119		
	Total	31.091	21			
speaking rough	Between Groups	22.121	14	1.580	.587	.812
	Within Groups	18.833	7	2.690		
	Total	40.955	21			
speaking voice breaks	Between Groups	12.985	14	.927	.628	.783
	Within Groups	10.333	7	1.476		
	Total	23.318	21			
speaking unstable pitch	Between Groups	7.152	14	.511	.335	.961
	Within Groups	10.667	7	1.524		
	Total	17.818	21			
speaking hard glottal attack	Between Groups	19.652	14	1.404	2.680	.097
	Within Groups	3.667	7	.524		
	Total	23.318	21			
speaking vocal fry	Between Groups	35.424	14	2.530	1.586	.276
	Within Groups	11.167	7	1.595		
	Total	46.591	21			
speaking audible inhilation	Between Groups	17.485	14	1.249	1.116	.465
	Within Groups	7.833	7	1.119		
	Total	25.318	21			
speaking hypernasal	Between Groups	8.106	14	.579	.442	.908
	Within Groups	9.167	7	1.310		
	Total	17.273	21			
speaking hyponasality	Between Groups	10.333	14	.738	1.409	.335
	Within Groups	3.667	7	.524		
	Total	14.000	21			

Table 2.27: Effect of singing training one the quality of one's voice in speech when taking separate voice parameters into consideration

		Sum of Squares	df	Mean Square	F	Sig.
singing hoarse	Between Groups	34.500	14	2.464	1.917	.196
	Within Groups	9.000	7	1.286		
	Total	43.500	21			
singing breathy	Between Groups	28.091	14	2.006	2.006	.179
	Within Groups	7.000	7	1.000		
	Total	35.091	21			
singing hyperfunctional	Between Groups	50.152	14	3.582	4.853	.022
	Within Groups	5.167	7	.738		
	Total	55.318	21			
singing hypofunctional	Between Groups	18.030	14	1.288	1.545	.289
	Within Groups	5.833	7	.833		
	Total	23.864	21			
singing gratings	Between Groups	45.621	14	3.259	1.279	.387
	Within Groups	17.833	7	2.548		
	Total	63.455	21			
singing rough	Between Groups	54.939	14	3.924	1.916	.196
	Within Groups	14.333	7	2.048		
	Total	69.273	21			
singing voice breaks	Between Groups	29.606	14	2.115	4.037	.035
	Within Groups	3.667	7	.524		
	Total	33.273	21			
singing unstable pitch	Between Groups	27.606	14	1.972	1.800	.221
	Within Groups	7.667	7	1.095		
	Total	35.273	21			
singing hard glottal attack	Between Groups	40.091	14	2.864	2.358	.129
	Within Groups	8.500	7	1.214		
	Total	48.591	21			
singing vocal fry	Between Groups	44.439	14	3.174	1.212	.417
	Within Groups	18.333	7	2.619		
	Total	62.773	21			
singing audible inhalation	Between Groups	16.485	14	1.177	.933	.570
	Within Groups	8.833	7	1.262		
	Total	25.318	21			
singing nasal	Between Groups	28.030	14	2.002	.628	.783
	Within Groups	22.333	7	3.190		
	Total	50.364	21			
singing hyponasal	Between Groups	20.818	14	1.487	2.313	.134
	Within Groups	4.500	7	.643		
	Total	25.318	21			

Table 2.28: The effect of speaking competency on the quality of one's voice in singing when taking separate voice parameters into consideration

		Sum of Squares	df	Mean Square	F	Sig.
singing hoarse	Between Groups	15.952	12	1.329	.506	.861
	Within Groups	21.000	8	2.625		
	Total	36.952	20			
singing breathy	Between Groups	5.952	12	.496	.151	.998
	Within Groups	26.333	8	3.292		
	Total	32.286	20			
singing hyperfunctional	Between Groups	32.071	12	2.673	1.245	.388
	Within Groups	17.167	8	2.146		
	Total	49.238	20			
singing hypofunctional	Between Groups	13.571	12	1.131	.936	.557
	Within Groups	9.667	8	1.208		
	Total	23.238	20			
singing gratings	Between Groups	36.833	12	3.069	1.238	.391
	Within Groups	19.833	8	2.479		
	Total	56.667	20			
singing rough	Between Groups	19.119	12	1.593	.282	.976
	Within Groups	45.167	8	5.646		
	Total	64.286	20			
singing voice breaks	Between Groups	11.119	12	.927	.536	.841
	Within Groups	13.833	8	1.729		
	Total	24.952	20			
singing unstable pitch	Between Groups	18.905	12	1.575	.804	.646
	Within Groups	15.667	8	1.958		
	Total	34.571	20			
singing hard glottal attack	Between Groups	39.976	12	3.331	3.402	.045
	Within Groups	7.833	8	.979		
	Total	47.810	20			
singing vocal fry	Between Groups	21.143	12	1.762	.365	.944
	Within Groups	38.667	8	4.833		
	Total	59.810	20			
singing audible inhalation	Between Groups	14.643	12	1.220	.930	.561
	Within Groups	10.500	8	1.313		
	Total	25.143	20			
singing nasal	Between Groups	23.976	12	1.998	.619	.781
	Within Groups	25.833	8	3.229		
	Total	49.810	20			
singing hyponasal	Between Groups	10.143	12	.845	.451	.897
	Within Groups	15.000	8	1.875		
	Total	25.143	20			

Table 2.29: Effect of singing competency of the quality of one's voice in singing when taking separate voice parameters into consideration

		Sum of Squares	df	Mean Square	F	Sig.
speaking hoarseness	Between Groups	4.738	12	.395	.177	.996
	Within Groups	17.833	8	2.229		
	Total	22.571	20			
speaking breathiness	Between Groups	13.143	12	1.095	.526	.848
	Within Groups	16.667	8	2.083		
	Total	29.810	20			
speaking hyperfunction	Between Groups	10.071	12	.839	.267	.980
	Within Groups	25.167	8	3.146		
	Total	35.238	20			
speaking hypofunctional	Between Groups	9.952	12	.829	1.327	.352
	Within Groups	5.000	8	.625		
	Total	14.952	20			
speaking gratings	Between Groups	16.738	12	1.395	1.313	.358
	Within Groups	8.500	8	1.063		
	Total	25.238	20			
speaking rough	Between Groups	25.476	12	2.123	1.185	.416
	Within Groups	14.333	8	1.792		
	Total	39.810	20			
speaking breaks	Between Groups	18.452	12	1.538	2.734	.081
	Within Groups	4.500	8	.563		
	Total	22.952	20			
speaking unstable pitch	Between Groups	7.667	12	.639	.807	.644
	Within Groups	6.333	8	.792		
	Total	14.000	20			
speaking hard glottal attack	Between Groups	11.905	12	.992	1.488	.292
	Within Groups	5.333	8	.667		
	Total	17.238	20			
speaking vocal fry	Between Groups	34.738	12	2.895	1.957	.173
	Within Groups	11.833	8	1.479		
	Total	46.571	20			
speaking audible inhalation	Between Groups	14.905	12	1.242	2.293	.123
	Within Groups	4.333	8	.542		
	Total	19.238	20			
speaking hypernasal	Between Groups	12.738	12	1.062	1.887	.187
	Within Groups	4.500	8	.563		
	Total	17.238	20			
speaking hyponasality	Between Groups	8.167	12	.681	.933	.559
	Within Groups	5.833	8	.729		
	Total	14.000	20			

Table 2.30: Effect of speaking competency on the quality of one's voice in speech when taking separate voice parameters into consideration

2.11 Summary

The main finding was that the level of perceived singing competency had a significant effect on specific voice parameters but on all. The second finding was that singing training may have a deteriorating effect on other overall quality of children's voices. The third finding was that the level of perceived speaking competency does not have a significant effect on the overall quality of a child's voice. The findings indicate that the refined and enhanced skill in one vocal behaviour does not necessarily result in improved vocal functioning and voice quality in that specific vocal behaviour or other vocal behaviours. Rather, refined skill in one vocal behaviour may result in deteriorated vocal functioning and voice quality.

2.12 Psychological factors

Data for psychological background factors was gathered via questionnaires and interviews. Each method was carried out with the individual participants (see Chapter Five for methods and the procedure). The data were analysed qualitatively with the assistance of Excel-software and quantitatively with the use of SPSS-software version 13.0. The data were divided into five categories, which had been formulated prior to data collection on the basis of an extensive literature review (see Chapter Three for the literature review). The interview and questionnaire items were formulated on the basis of the five primary themes that were used for structuring the data. The themes represented the proposed theoretical framework (see Chapter Three for the framework). These five categories were: learning and behavioural difficulties; self-esteem and self-worth; personality characteristics; vocal identity; and attitude to singing.

2.13 Learning and behavioural difficulties

Different types of learning and behavioural difficulties were looked at in the analyses. These difficulties were: speaking difficulties, reading difficulties and behavioural difficulties.

2.13.1 Speaking difficulties

The main finding was that, when a child possesses a speech disorders, (s)he is likely to possess unhealthy overall voice quality (and vice versa) (see Figure 2.13 below). The correlation between these two factors was statistically significant ($r= 0.842$; $p < 0.05$) (see Table 2.31) when looking at the whole class. The same finding was discovered when looking at unhealthier overall voice quality in singing and its potential connections to speech difficulties. The correlation was statistically significant for the whole class ($r=0.689$; $p < 0.05$) (see Table 2.32). Such findings indicate that unhealthier overall voice quality may influence a child's ability to speak. Alternatively, difficulties in speaking may significantly influence the quality of the child's voice in both speech and singing. A further alternative explanation is that there is a third factor (such as one's environment) that is causing the speech and voice distortions to manifest.

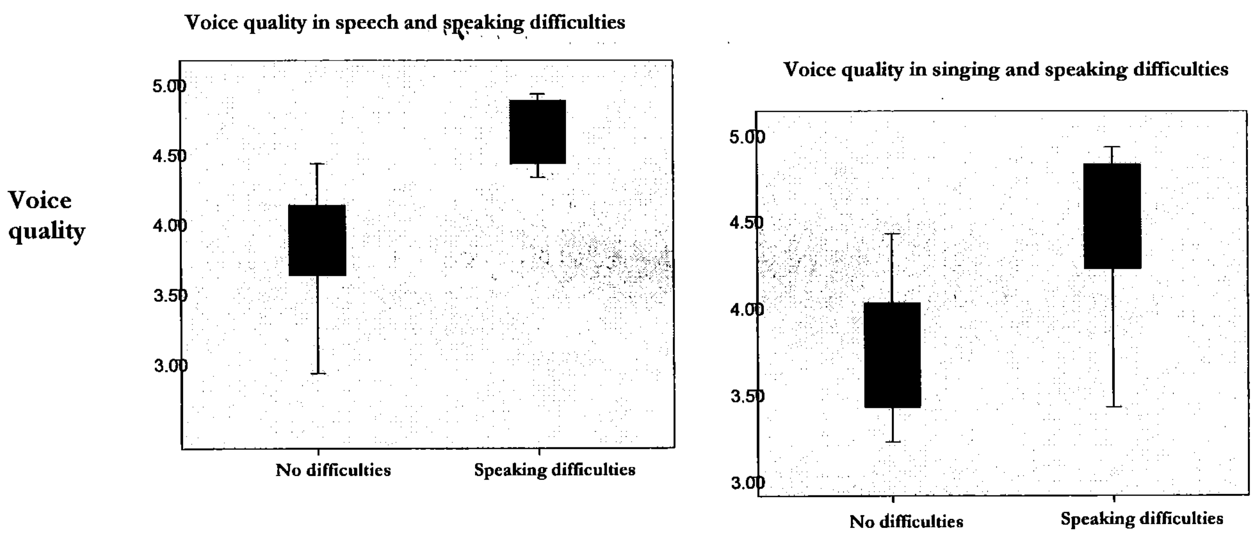


Figure 2.13: Boxplots forthe relationship between speaking difficulties and voice quality in speech (left figure) and voice quality in singing and speaking difficulties(right figure)

			overall speaking	speech problems
Spearman's rho	overall speaking	Correlation Coefficient	1.000	.842(**)
		Sig. (2-tailed)	.	.000
		N	22	22
	speech difficulties	Correlation Coefficient	.842(**)	1.000
		Sig. (2-tailed)	.000	.
		N	22	22

Table 2.31: Relationship between speaking difficulty and one's overall voice quality in speech

			speech problems	overall singing
Spearman's rho	speech difficulties	Correlation Coefficient	1.000	.689(**)
		Sig. (2-tailed)	.	.000
		N	22	22
	overall singing	Correlation Coefficient	.689(**)	1.000
		Sig. (2-tailed)	.000	.
		N	22	22

Table 2.32: Correlation between one's overall voice quality in singing and speaking difficulty for the whole class

2.13.2 Reading difficulties

The main finding was that the children who exhibited unhealthier overall voice quality in speech were likely to possess difficulties with reading. For the whole class, the relationship between reading difficulties and overall voice quality in speech was significant ($r=0.573$; $p < 0.05$) (see Table 2.33). The relationship between reading difficulties and overall voice quality in singing was not significant for the whole class ($r=0.404$; n.s) (see Table 2.34) (see Figure 2.14 below). Such findings indicate that reading difficulties may have an impact on children's overall voice quality in speech but not in singing, or that distorted voice quality in speech may have an effect on children's reading ability. A further alternative explanation is that a third factor (such as one's psychological well-being) may have caused both the voice distortions and the reading difficulties to manifest.

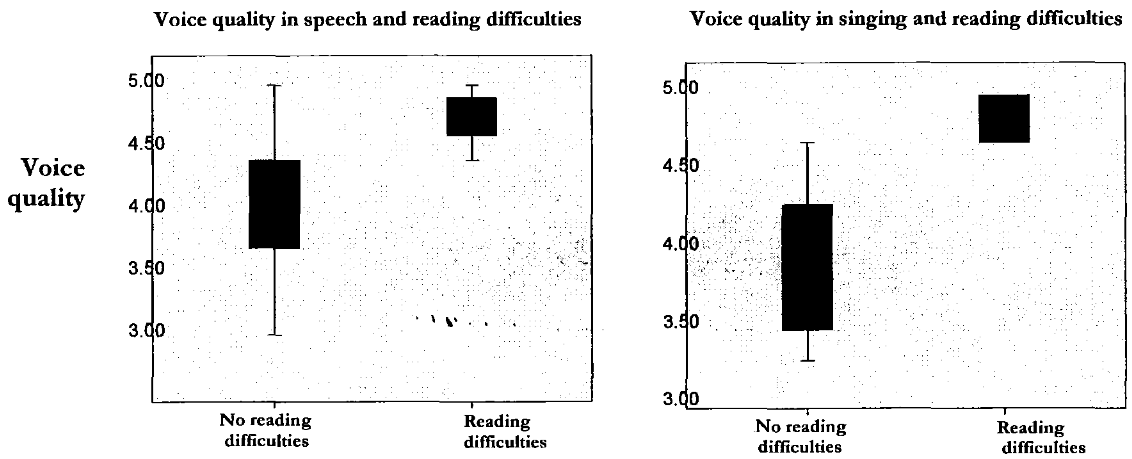


Figure 2.14: Boxplots for the relationship between voice quality in speech and reading difficulties (left figure) and voice quality in singing and reading difficulties (right figure)

			overall speaking	Read diff.
Spearman's rho	overall speaking	Correlation Coefficient	1.000	.573(**)
		Sig. (2-tailed)	.	.005
		N	22	22
	Reading difficulties	Correlation Coefficient	.573(**)	1.000
		Sig. (2-tailed)	.005	.
		N	22	22

Table 2.33: Correlation between overall voice quality in speech and reading difficulty for the whole class

			Reading difficulty	overall singing
Spearman's rho	Reading difficulties	Correlation Coefficient	1.000	.404
		Sig. (2-tailed)	.	.062
		N	22	22
	overall singing	Correlation Coefficient	.404	1.000
		Sig. (2-tailed)	.062	.
		N	22	22

Table 2.34: Correlation between overall voice quality in singing and reading ifficulty for the whole class

2.13.3 Behavioural difficulties

The main finding was that the children who possessed unhealthier overall voice quality were likely to exhibit a behavioural difficulty. The information for identifying the children who possessed a behavioural difficulty was obtained from the school records, with the permission of the head teacher and the children's parents. The correlation between children's overall voice quality in speech and behavioural difficulty was statistically significant for the whole class ($r=0.780$; $p < 0.05$) (see Table 2.35). There was also a statistically significant correlation between behavioural difficulties and children's overall voice quality in singing ($r=0.489$; $p= 0.021 < 0.05$) (see Table 2.36) (see Figure 2.15 below). Such findings indicate that behavioural difficulties may have an impact on children's overall voice quality in speech but not in singing, or that distorted voice quality in speech may have a deteriorating effect on children's behaviour. As with speech disorder and reading difficulties, further alternative explanation is that a third factor (such as a physiological factor) may have caused both the voice distortions and the behavioural difficulties to manifest.

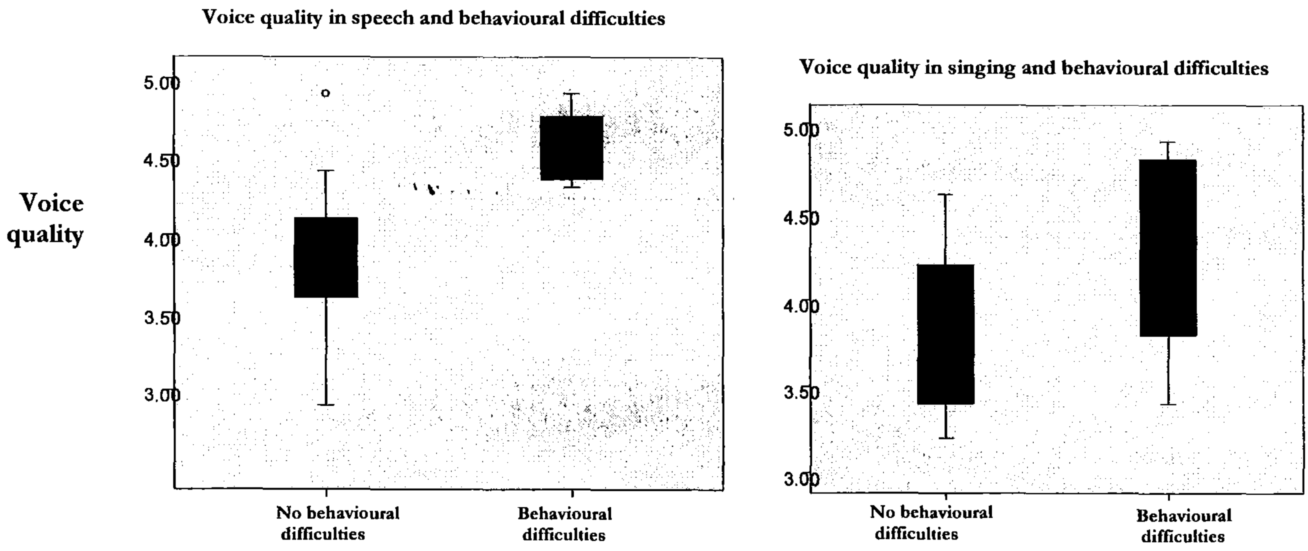


Figure 2.15: Boxplots for the relationship between voice quality in speech and behavioural difficulty (left figure) and voice quality in singing and behavioural difficulty (right figure)

			behavioural problem	overall speaking
Spearman's rho	behavioural problem	Correlation Coefficient	1.000	.780(**)
		Sig. (2-tailed)	.	.000
		N	22	22
	overall speaking	Correlation Coefficient	.780(**)	1.000
		Sig. (2-tailed)	.000	.
		N	22	22

** Correlation is significant at the 0.01 level (2-tailed).

Table 2.35: Correlation between behavioural difficulty and overall voice quality in speech for the whole class

			behavioural problem	overall singing
Spearman's rho	behavioural problem	Correlation Coefficient	1.000	.489(*)
		Sig. (2-tailed)	.	.021
		N	22	22
	overall singing	Correlation Coefficient	.489(*)	1.000
		Sig. (2-tailed)	.021	.
		N	22	22

Table 2.36: Correlation between behavioural difficulty and overall voice quality in singing for the whole class

2.14 Vocal identity

In order to investigate whether the overall quality of the children's voice had an effect on how their vocal identity, comparisons were made between children possessing healthier overall voice quality (ratings from 1 to 3) (N=4) and children possessing unhealthier overall voice quality (ratings from 5 to 7) (N=4). Interviews and questionnaires were employed in gathering the data (see Appendices for questionnaire and interview schedules). The data were analysed qualitatively, with the help of EXCEL-software programme.

The first finding was that all of the participating children regarded 'speaking' and 'singing voices' as two separate entities. They all stated that everyone has 'a speaking voice' that is used for speaking and 'a singing voice' that is used for singing. As an example, one child stated:

'Of course your voice is different when you speak and different when you sing...The sound is so different that it can't be the same voice.'

The second finding was that the children possessing healthier overall voice quality stated that they liked the way their voices sounded both in speech and singing, whilst the children with unhealthier overall voice quality stated that they did not like the way their voices sounded in either vocal behaviour. Half of the children with unhealthier overall voice quality stated that they did not like the way their 'speaking voices' sounded, whilst they liked the way their 'singing voices' sounded. The remaining half of the children with unhealthier voice quality stated that they did not mind the way their 'speaking voices' sounded but they minded the way their 'singing voices' sounded. For instance, a child with healthier overall voice quality claimed:

'I like my voice when I speak...It sounds normal. It also sounds wonderful when I sing.'

Another example is from a child with unhealthier overall voice quality:

'I don't really think about my voice. I don't mind it when I speak...When I sing...Hhhmmm...I don't know...'

The third finding was that the children who had undergone a greater amount of singing training (i.e. belonged to the Singing Group) did not describe their 'speaking voices' as positively as they described their 'singing voices' and the children who had not undergone as much singing training (i.e. belonged to the Non-singing Group) described their 'speaking voices' with relatively negative terms. For example, the children from the Singing Group described their 'speaking voices' as fast, loud and shouty. A boy stated:

'It's very loud....'

The children from the Non-singing Group described their 'speaking voices' as horrible or dislikeable. A girl argued:

'It is horrible...It just doesn't sound nice at all.

2.15 Self-esteem and self-worth

The level of the children's self-esteem and self-worth were investigated through a personality intervention. The personality intervention used was the Eysenck Junior Personality-test (see Appendix 1 for the full test). The results were analysed according to the guidelines set in the manual designed for the test, by providing each child with a score for each personality characteristic listed in the inventory and by analysing the results qualitatively. The scores ranged from 0 to 6 and from descendent to ascendant, depending on the personality characteristic. Due to the inconsistent nature of the scoring, statistical analysis was not feasible. In the qualitative analysis, comparisons were made between the Singing Group and the Non-singing Group, as well as between children with healthier overall voice quality and children with unhealthier overall voice quality.

The first finding was that the children from the Singing Group and the children with healthier overall voice quality viewed themselves in more positive terms than the children from the Non-singing Group and the children with unhealthier overall voice quality did. The majority of the children from the first group described themselves as confident, happy, talkative and cheerful, whilst the majority of the children from the second group described themselves as quiet yet happy. All of the children in the first group stated that they felt confident, whilst only half of the children in the second group stated that they felt confident. Such findings suggest that the better the children feel about their voices, the better they feel about themselves (see Table 2.37). Alternatively, it may be that there is a third external factor (such as one's local environment) that is equally influencing both entities.

The second finding was that the children with unhealthier overall voice quality regarded themselves as less confident than their peers with healthier overall voice quality did. Nevertheless, the majority of the children with unhealthier overall voice quality regarded themselves as happy. Such findings imply that the quality of children's voices may have an impact on their self-confidence, as well as their self-esteem. However, there may have been external factors that facilitated the recorded differences between the children.

Characteristic	**The Singing Group (N=13)**	**The Non-singing Group (N=9)**	**Healthy voice (N=12)**	**Unhealthy voice (N=10)**
Confident	92 % (N=12/ 13)	33.3 % (N= 3/ 9)	100 % (N= 12/ 12)	30 % (N= 3/ 10)
Happy	100% (N=13/ 13)	77.8 % (N= 7/ 9)	100 % (N= 12/ 12)	80 % (N 8/ 10)
Quiet	7.7% (N=1/ 13)	77.8 % (N= 7/ 9)	25 % (N= 3/ 12)	70 % (N = 7/ 10)
Angry	0 % (N= 0/ 13)	66.7 % (N= 6/ 9)	0 % (N= 0/ 12)	60 % (N= 6/ 10)

Table 2.37: Percentages of biographical perceptions for different groups of children

The second finding was that the children belonging to the Singing Group and children with healthier overall voice quality possessed higher levels of self-worth than the children from the Non-singing Group and children with unhealthier overall voice quality did. The children from the first group were more confident when enquired about future events. For example, the children from the Singing Group were more likely to say that they would do well at school in a few years' time, or that they would be able to engage in any type of activity or hobby, than the children from the Non-singing Group were likely to state (see Table 2.38).

Items measuring self-worth / self-esteem	The Singing Group (N=13)	The Non-singing Group (N=9)	Unhealthy voice quality (scores 5-7) (N= 17)	Healthy voice quality (scores 1-3) (N= 18)
(S)he believes that (s)he would do well in a future event.	100 % (N= 13/ 13)	55.6 % (N= 5/ 9)	47.1% (N= 8/ 17)	72.2% (N= 13/ 18)
(S)he believes that (s)he would be able to engage in any type activity.	84.6 % (N= 11/ 13)	22 % (N= 2/9)	52.9% (N= 9/ 17)	72.2% (N= 13/18)

Table 2.38: Percentages of the responses received for self-worth and self-esteem statements

2.16 Personality characteristics

The children's personality characteristics were investigated via the Eysenck Junior Personality-test (see Appendixes for the full test). The results were analysed according to the guidelines provided in the manual designed for the test. Each child was given a score for each specific personality characteristic (see Section 2.18 for full description on the analyses for the test).

The main finding was that the children belonging to the Singing Group and the children with healthier overall voice quality scored most points for being extraverted and hyperactive. These particular children scored hardly any points for being obedient and shy. The children from the Non-singing Group and the children with unhealthier overall voice quality scored most points for being obedient. They also scored more points for being shy than they did for being hyperactive. Such findings indicate that the children from the Singing Group were more active than the children from the Non-singing Group were (see Table 2.39).

Group	Hyperactive and Extraverted	Shy and Introverted	Obedient and Well-behaved (in addition to being either hyperactive or shy)
Singing Group (N=13)	76.9 % (N= 10/ 13)	23.1 % (N= 3/ 13)	38.5 % (N= 5/ 13)
Non-singing Group (N=9)	22.2 % (N= 2/ 9)	77.8 % (N= 7/ 9)	88.9 % (N= 8/ 9)
Healthy overall voice quality (N=4)	16.7 % (N= 3/ 4)	91.7 % (N= 3/ 4)	75 % (N= 3/ 4)
Unhealthy overall voice quality (N=4)	75 %	25% (N= 1/4)	50% (N= 2/4)

Table 2.39: Percentages of personality characteristics for separate groups of children

2.17 Singing and other musical engagement

The children's singing and other musical engagement were investigated via interviews (see Appendixes for full interview schedule). The children were enquired about their musical hobbies and their reasons for being involved in such activities (including singing activities). The results were analysed qualitatively with the assistance of EXCEL-software.

The first finding was that the children who had received a greater amount of formal singing training were more likely to be engaged in additional musical activities than the children who had not received an equal amount of singing training were. The majority of the children belonging to the former group played a musical instrument or even several musical instruments. The children belonging to the latter group did not, in general, have other musical hobbies (see Table 2.40). It should be noted, however, that there may have been external factors (such as local culture) that contributed to the recorded differences between the children.

Additional musical hobby	The Singing Group (N=13)	The Non-singing Group (N=9)	Healthy voice (N=4)	Unhealthy voice (N=4)
Playing of musical instrument(s)	92 % (N= 12/ 13)	22 % (N= 2/ 9)	100 % (N-=4/4)	25 % (N= 1/ 4)
Other (such as drama	7.7 % (N= 1/ 13)	11 % (N= 1/ 9)	0 % (N 0/ 4)	25% (N= 1/ 4)

Table 2.40: Prevalence of additional musical hobbies for children in the Singing Group and in the Non-singing Group

The second finding was that there were differences between the responses received from the children belonging to the Singing Group and those belonging to the Non-singing Group when enquired about reasons for being engaged in singing and other musical activities. The children from the Singing Group stated that they found singing and other musical activities relaxing, enjoyable and a means to cope with daily life. For example, one girl from this particular group stated:

'I just sing to save my life away.'

The children belonging to the Non-singing Group stated that they sang or got engaged in musical activities only when they had to. When this latter group of children were enquire about their reasons for disliking singing and other musical activities, the children were not always able to provide answers to such questions. They simply stated that they just did not like such activities. For instance, one boy stated:

'I don't know...I just don't like it. I don't feel comfortable in doing such things.

2.18 Psychological impact of singing

The psychological impact of singing was investigated via questionnaires. The same questionnaire was used for the inquiry as the one that investigated the children's attitudes towards singing and musical activities (see Appendices for full questionnaire schedule). The results were analysed qualitatively with the assistance of EXCEL-software programme. Comparisons were made between children belonging to the Singing Group and children belonging to the Non-singing Group.

The main finding was that the children belonging to the Singing Group stated that they felt very relaxed and uplifted subsequent to being engaged in singing or other musical activities. The children also stated that singing offered them something fun to do. For instance, one girl stated:

'I just feel so good when I sing. It makes me happy and relaxed.'

The children from the Non-singing Group stated that they found singing and musical activities daunting and anxiety-provoking. They stated that they did not find such activities relaxing at all but rather stressful. For example, one girl stated:

'It is scary. Your heart goes pump, pump, pump…'

2.19 Summary

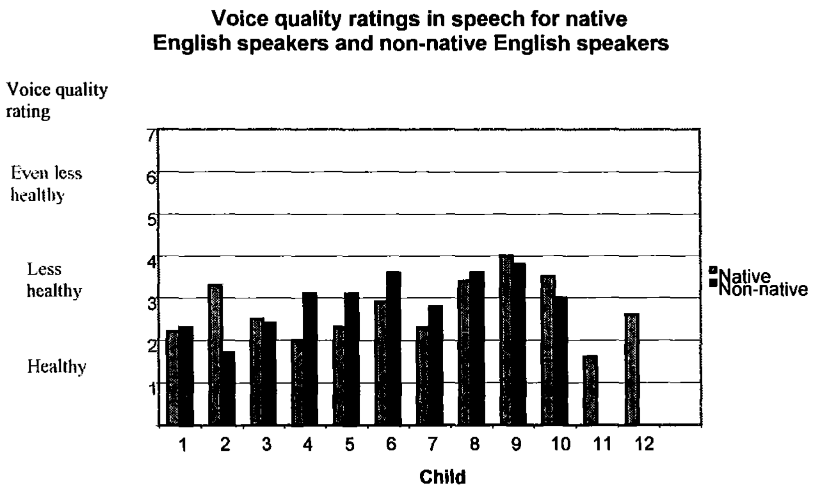
From the findings above, it is evident that a number of psychological factors are connected to children's overall vocal functioning and voice quality in both speaking and singing behaviours. Voice quality seems to be connected to a network of psychological factors that consists of: learning difficulties; reading difficulties; speech difficulties; behavioural difficulties; vocal identity; levels of self-esteem and self-worth; and personality characteristics. Singing seems to have an impact on such a network of factors.

2.20 Sociological factors

Data for sociological background factors were gathered via questionnaires, interviews and observation. The questionnaire, interview and observation items had been formulated on the basis of an extensive literature review (see Chapter Three for the literature review). The data were analysed with the assistance of EXCEL-software programme. The findings were divided into six categories, which had been formulated on the basis of the same literature review. These categories were: linguistic background; siblings; sex; socioeconomic background; age; and leisure activities.

2.21 Linguistic background

There were 11 native English speakers and 11 non-native English speakers in the class. The majority of the children who were native English speakers possessed healthier overall voice quality (i.e. the average rating for their overall voice quality in speech and in singing was below 5.0). The children who were non-native English speakers possessed unhealthier overall voice quality than their native peers did (see Figure 2.16).



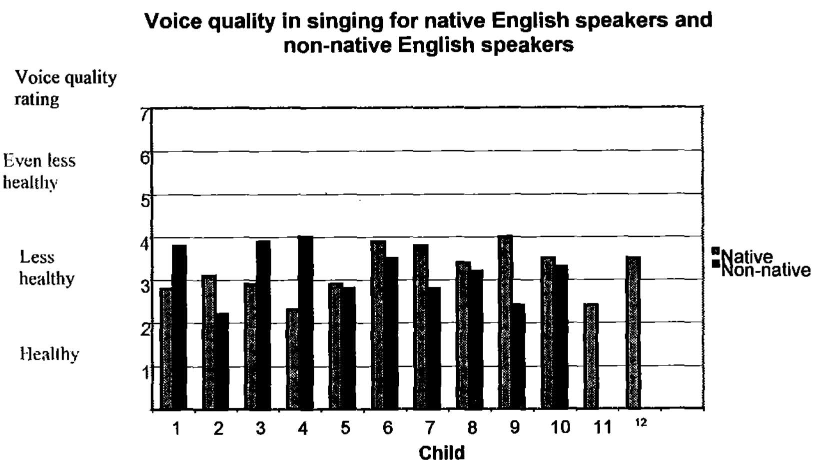


Figure 2.16: Distribution of overall voice quality ratings in speech and in singing for native English speakers and non-native English speakers

The children who spoke Arabic or Somali at home exhibited the unhealthiest overall voice quality out of the children in this particular class (see Table 2.41). The average rating for their overall voice quality rating in speech was 4.7. This indicates that native speakers possessed healthier voice quality in speech and in singing than non-native speakers did.

First language	Unhealthy voice quality in speech	Unhealthy voice quality in singing
English	10%	10%
Arabic	90%	80%
Somali	90%	75%
Other	56.5%	50.5%

Table 2.41: Prevalence of unhealthy voice quality in speech and in singing for native English speakers and non-native English speakers

It should be noted, however, that the judges may have been culturally-biased when performing their voice assessment task. They may have been accustomed to listening to particular types of voice quality that can be regarded 'normal' in their own culture (such as a degree of nasality in the vocal product). Therefore, they may have judged voice qualities regarded as 'normal' and healthy in other cultures (such as Arabic countries) as 'abnormal' and unhealthy. It may be that judges from other countries (such as Somalia) may not have rated the children from their countries as possessing 'abnormal' and unhealthy voice quality as easily as the judges who participated in the study did.

2.22 Siblings

Comparisons were made between the children possessing more than two siblings and those possessing less than two siblings. Number of siblings did not have a significant effect on the overall quality of the children's voices neither in speech nor in singing (see Table 2.42). It should be noted that, since majority of the children possessed more than two siblings, it may be difficult to draw any firm conclusions from the findings. Nevertheless, the children who did not have any siblings did not differ significantly in their overall voice quality from those who had more than two siblings (see Table 2.42).

Number of siblings	Unhealthy Voice Quality in Speech	Unhealthy Voice Quality in Singing
More than two (N= 14)	21.4% (N= 3/ 14)	7.1% (N= 1/ 14)
Less than two (N- 8)	12.5% (N= 1/ 8)	12.5% (N= 1/ 8)

Table 2.42: Prevalence of voice distortions and the number of siblings

The children who were the eldest in their family possessed the unhealthiest overall voice quality in both vocal behaviours when comparing children of different sibling orders (see Table 2.43). The average rating for overall voice quality for the eldest siblings in speech was 4.8 and 4.7 in singing. The children who: had no siblings, were the youngest ones in the family; or only had one younger sibling, possessed the healthiest overall voice quality in both vocal behaviours. The average rating for their voice quality in both speech and singing was 3.5. The children who had both older and younger siblings possessed relatively healthy voice quality in both speech and singing, with their average ratings clustering between 4.0 and 4.5 in both speech and singing. The above findings were verified by non-parametric statistical analysis. The difference between voice quality ratings for the youngest siblings and the eldest siblings was statistically significant when taking both their speaking and singing behaviours into consideration (Kruswall Wallis, $F(18)$; $p < 0.05$). Such findings indicate that the fact of whether a child is first-born or a late-born in the family may influence his/ her overall vocal functioning and voice quality.

Sibling order	Mean rating for voice quality in speech	Mean rating for voice quality in singing
Eldest	4.8 (unhealthy)	4.7 (unhealthy)
Youngest or no siblings	3.5 (healthy)	3.5 (healthy)
Middle sibling	4.0 (slightly unhealthy)	4.5 (unhealthy)

Table 2.43: Prevalence of unhealthy voice quality characteristics and sibling order

2.23 Sex

There were significant differences between boys and girls in terms of their overall vocal functioning and voice quality (see Figure 2.17). Girls exhibited unhealthier overall voice quality in both vocal behaviours than boys did. The average rating was 4.2 in speech and 4.5 in singing for girls. For boys, the average rating was 4.3 in speech and 3.9 in singing. The unhealthiest voice quality (clustering around 5.0) was found in four girls and two boys. In addition, voice quality was healthier in singing than in speech for boys, whilst it was healthier in speech than in singing for girls. Such a finding was a surprise since it contradicted findings from previous studies (see Chapter Two).

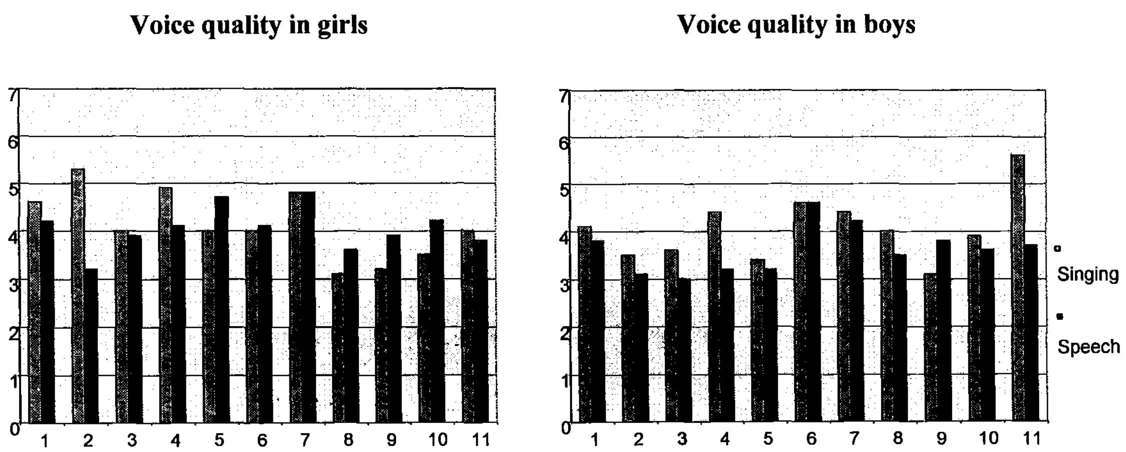
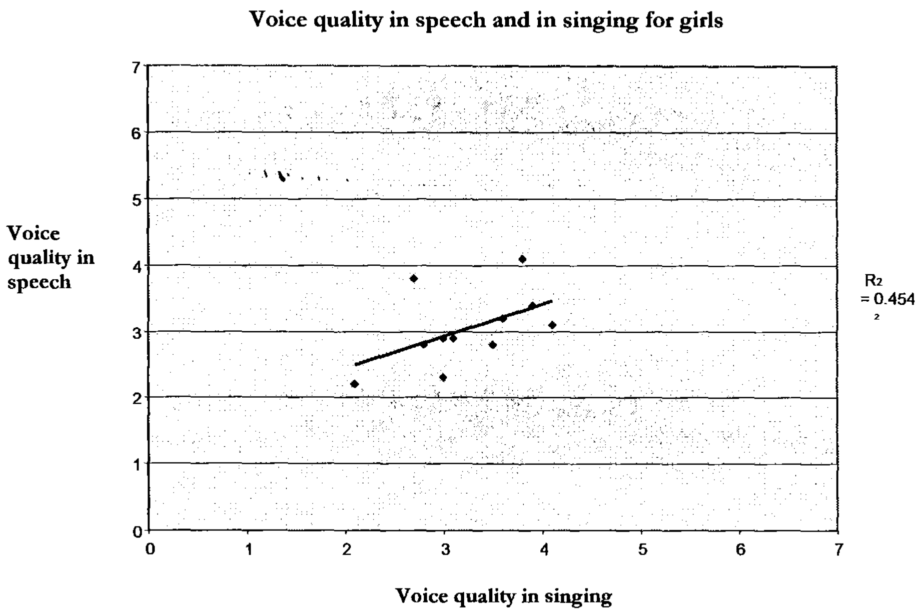


Figure 2.17: Relationship between sex and overall voice quality in speech and singing

Non-parametric statistical analysis verified the findings since the difference between females and males was found to be statistically significant (Kruswall Wallis, $F(12)$; $p < 0.05$) (see Figure 2.18). Such findings indicate that girls possessed unhealthier overall vocal functioning and voice quality in speaking and singing behaviours than boys did.



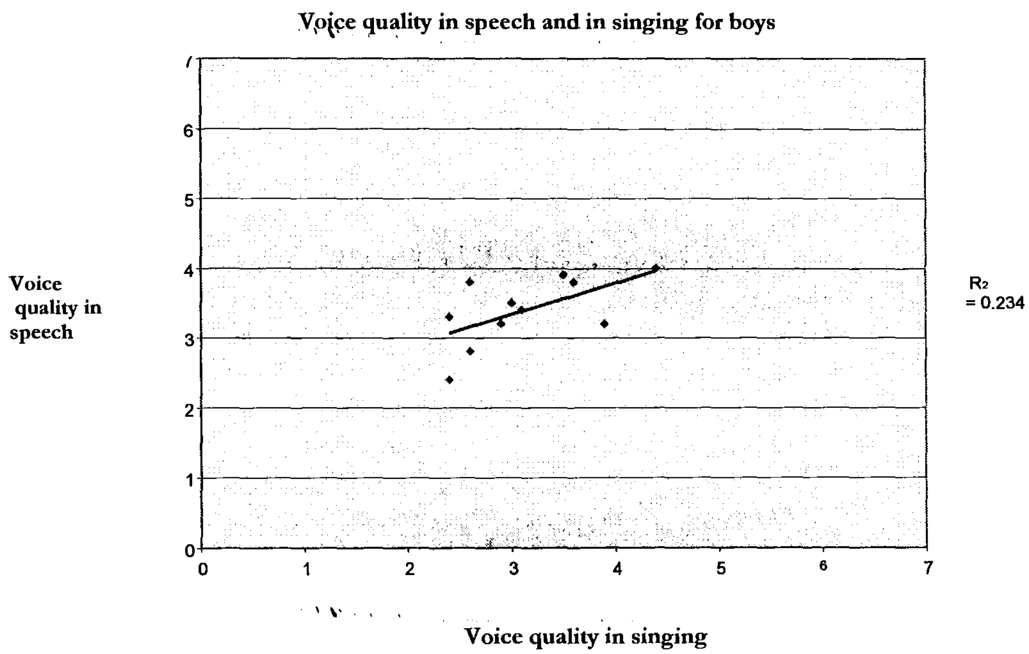


Figure 2.18: Scatterplot for voice quality in speech and voice quality in singing for girls (top figure) and boys (lower figure)

2.24 Socioeconomic status

The classification of socioeconomic status was formulated on the basis of information derived from the school regarding free school dinners. In the whole class, there were only three children who were classified as belonging to a lower socioeconomic status. Since there were only three children belonging to this group, statistical analysis was not feasible between children belonging to higher socioeconomic status families and those belonging to lower socioeconomic status families in order to investigating the influence of children's socio-economic background on the quality of their voice.

2.25 Age

All the children in this particular class were approximately ten years of age. However, a subset of the children was born earlier in the year. Therefore, the age for each child was calculated in months in order to investigate whether there was any statistically significant difference between older and younger children in terms of the overall quality of their voices.

There was no statistically significant relationship between the age of the children and their voice quality in speech ($r=0.79$; $p> 0.726$, n.s.) (see Table 2.44). There was no statistically significant relationship between age and overall voice quality in singing either ($r=0.321$; $p>0.145$, n.s.) (see Table 2.45). The findings indicate that age does not necessarily have a significant influence on children's overall vocal functioning and voice quality in either vocal behaviour. However, the age differences within this class of children were relatively minimal. Thus, it may be that, with more distinct age-groups, significant differences may be found.

		overall speaking	age of child in months
overall speaking	Spearman Correlation	1	.079
	Sig. (2-tailed)		.726
	N	22	22
age of child in months	Spearman Correlation	.079	1
	Sig. (2-tailed)	.726	
	N	22	22

Table 2.44: Correlation between age ad overall voice quality in speech

		age of child in months	overall singing
age of child in months	Spearman Correlation	1	.321
	Sig. (2-tailed)		.145
	N	22	22
overall singing	Spearman Correlation	.321	1
	Sig. (2-tailed)	.145	
	N	22	22

Table 2.45: Correlation between age and overall voice quality in singing

2.26 Leisure activities

Children with unhealthier overall voice quality (N=4) stated that they enjoyed active hobbies (such as playing in the playground with their friends or going to the park) in their leisure time. Children with healthier overall voice quality (N=4), on the other hand, preferred more solitary leisure activities (such as watching TV or playing computer games at home on their own (see Table 2.46). It may be that the children who exhibited unhealthier voice quality abused their voices during the leisure activities since such activities perhaps required higher vocal volume.

Group	Active hobbies	Passive hobbies	Mixed hobbies
Children with unhealthy voice qualities (N=4)	75% (N=3/ 4)	0% (N= 0/ 4)	25% (N= 1/ 4)
Children with healthy voice qualities (N=4)	25% (N= 1/ 4)	75% (N= 3/ 4)	50% (N= 2/ 4)

Table 2.46: Prevalence of leisure activities for children with healthier overall voice quality and those with unhealthier overall voice quality

2.27 Summary

The findings for the sociological factors can be summarised as follows:

a) Overall voice quality in speech and in singing was healthier in native English speakers than in non-native English speakers.

b) In native English speakers, voice quality was healthier in speech than in singing.

c) In non-native English speakers, voice quality was healthier in singing than in speech.

d) The number of siblings had no significant effect on one's voice quality.

e) The eldest siblings have the unhealthiest voice quality.

f) Girls possessed unhealthier overall voice qualities in both speech and singing than boys did.

g) Age had no significant effect on children's overall voice quality.

h) There was a relationship between vocal health and types of leisure activities.

Appendix 3: Second Study

3.1 Introduction and information on participants

The focus for this chapter is data from the second study (London, 2006). The analyses procedure from the first study was replicated for the second study in order to compare the findings from the two studies (see Section 6.1 for more details on the analyses).

The participants for the second study (London, 2006) were 18 children from the school located in inner London that the participant children for the first study were also from. As with the first study, all 18 children were assessed on the specially designed singing and speaking protocols (see Chapter Five for details on the protocol). The voice assessment analyses from the first study were replicated in the second study (see Section 6.3 for more details on the analyses).

3.2 Overall voice quality in speech and overall voice quality in singing

The descriptive statistics demonstrated that there was a minimal difference between the overall voice quality ratings in speech and the overall voice quality ratings in singing when looking at all the participants as a group (see Table 3.1 and Figure3.1). The mean rating for speech was 2.13 compared to 2.7 in singing for the whole group. The standard deviation was slightly greater for speech than for singing (0.985 versus 0.629). The range for the ratings varied by 2.70 points for speech (1.2-3.9) and by 2.40 for singing (1.2-3.6). The findings imply that the overall voice quality for the whole group was healthier in singing than in speech.

Group	Speech			Singing		
	Mean	**Standard Deviation**	**Range**	**Mean**	**Standard Deviation**	**Range**
Whole class (n=18)	2.13	0.985	2.70	1.75	0.629	2.40

Table 3.1 : Descriptive statistics for voice quality ratings in speech and those in singing where 1=healthy, 2=healthy, 3=healthy, 4=less healthy, 5=less healthy, 6=unhealthy, 7=extremely unhealthy (colours indicate three broad categories of vocal healthy, evidence of some vocal problem, or more extreme unhealthy voice use)

Neither type of vocal behaviour was highly rated on either end of the scale in terms of perceived vocal health, with each tending towards a mid-point on the seven-point scale. However, singing behaviour was perceived as healthier than speaking (healthier overall voice quality in singing for 11 children; healthier overall voice quality in speech for 2 children; equally healthy overall voice quality in both behaviours for 2 children). The bar chart below illustrates that the difference between overall voice quality in speech and overall voice quality in singing was relatively small for the majority of the children (see Figure 3.1).

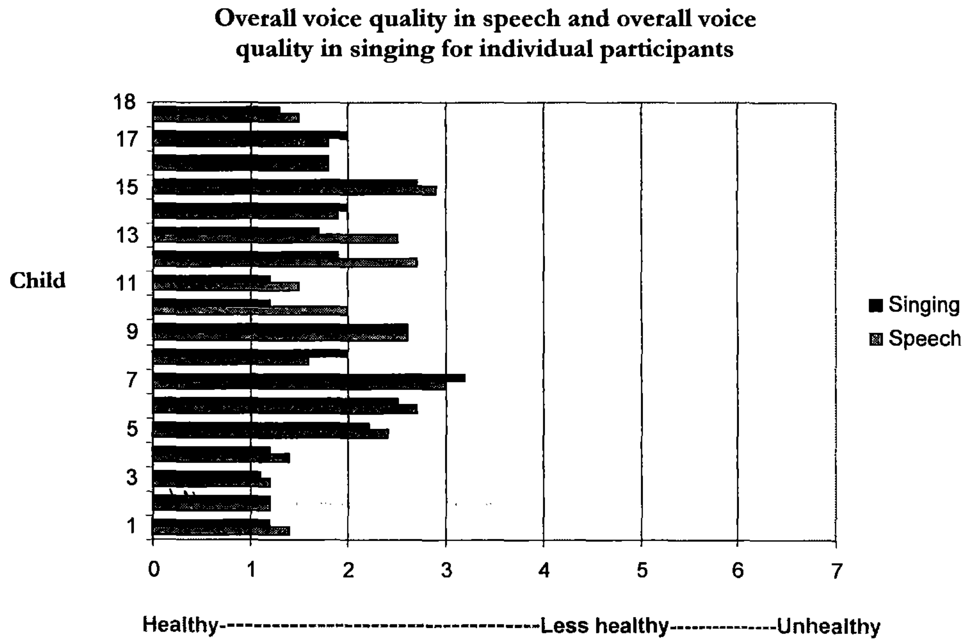


Figure 3.1: Bar chart for voice quality ratings in speech and in singing for the individual participants in the whole group

When the overall voice quality ratings were rank-ordered for speech and for singing, there were differences in their distributions (see Figure 3.2). For speech, the distribution was bipolar and positive (skewness distribution: 0.50), suggesting that the ratings clustered around two independent values. The first cluster fell between 1.00 and 1.50 and the second cluster fell between 3.50 and 4.00. This indicates that there were a number of children possessing healthy overall voice quality (i.e. clustering around 1.0) and a number of children possessing unhealthier overall voice quality (i.e. clustering around 4.0). For singing, the distribution was positively skewed (skewness distribution: 0.59), indicating that a greater number of ratings lay below the mean and within the range of relatively healthy voice quality. The greatest number of children fell between the ratings of 1.00 and 1.50.

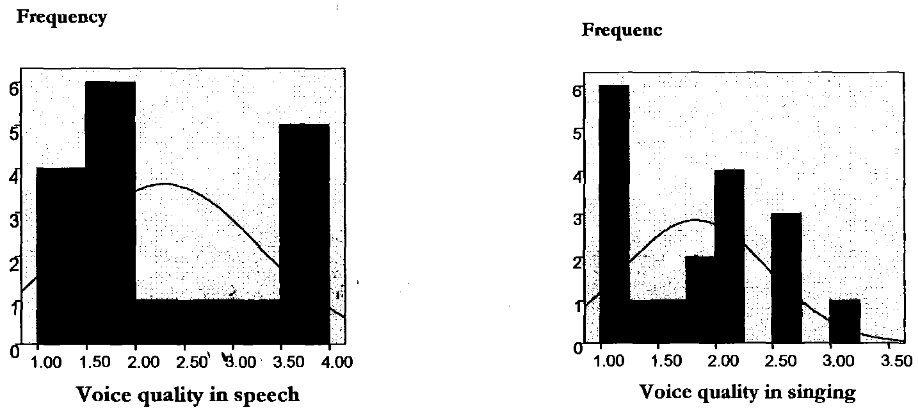


Figure 3.2: Distribution of rank-ordered voice quality ratings in speech (left figure) and those in singing (right figure) for the whole class

The scatterplot below (see Figure 3.3) illustrates the correlation between overall voice quality ratings in speech and those in singing for the whole class. The plot indicates a fairly strong positive correlation, which verifies the findings from the other non-parametric tests for the tendency of voice quality in one vocal behaviour to be associated with similar quality in the other ($r=0.766$; $p<0.05$) (see Table 3.2). The plot also illustrates that there were no obvious outliers within the voice quality ratings.

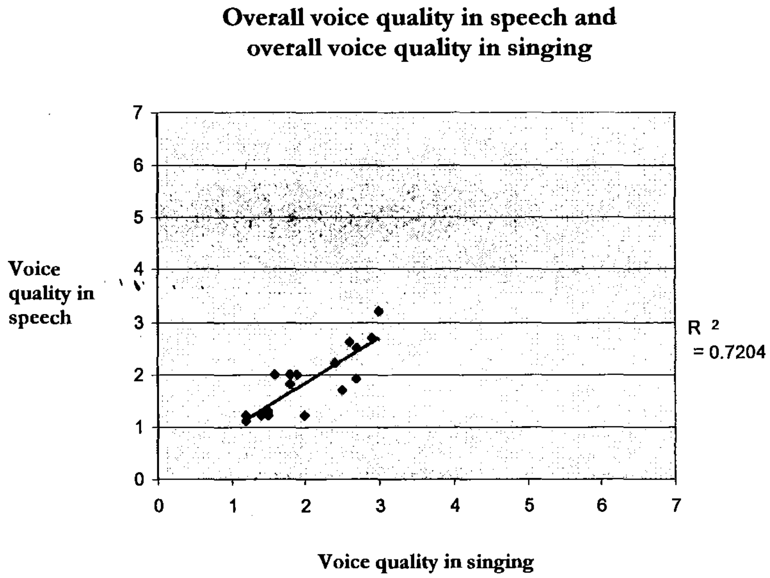


Figure 3.3: Correlation between voice quality ratings in speech and those in singing for the whole class

			voice quality in singing songs	voice quality in speech in reading
Spearman's rho	voice quality in singing	Correlation Coefficient	1.000	.766(**)
		Sig. (2-tailed)	.	.000
		N	18	18
	voice quality in speech	Correlation Coefficient	.766(**)	1.000
		Sig. (2-tailed)	.000	.
		N	18	18

Table 3.2: Correlation for overall voice quality in speech and overall voice quality in singing for the whole class

Similarly to the first study, the mode, median and standard deviations were calculated for each individual voice parameter in speech and for those in singing in order to investigate whether the mean ratings were a reliable measure for exploring and representing the gathered voice data (see Figure 3.4; Tables 3.3-3.6). The finding was that the correlations between each measure in speech and in singing were statistically significant (mode: $r=0.853$; $p<0.05$; median: $r=0.851$; $p<0.05$; standard deviation: $r=0.353$; $p<0.05$). The correlations were positive and relatively strong. This indicates that the mean ratings were an appropriate tool in analysing the voice data.

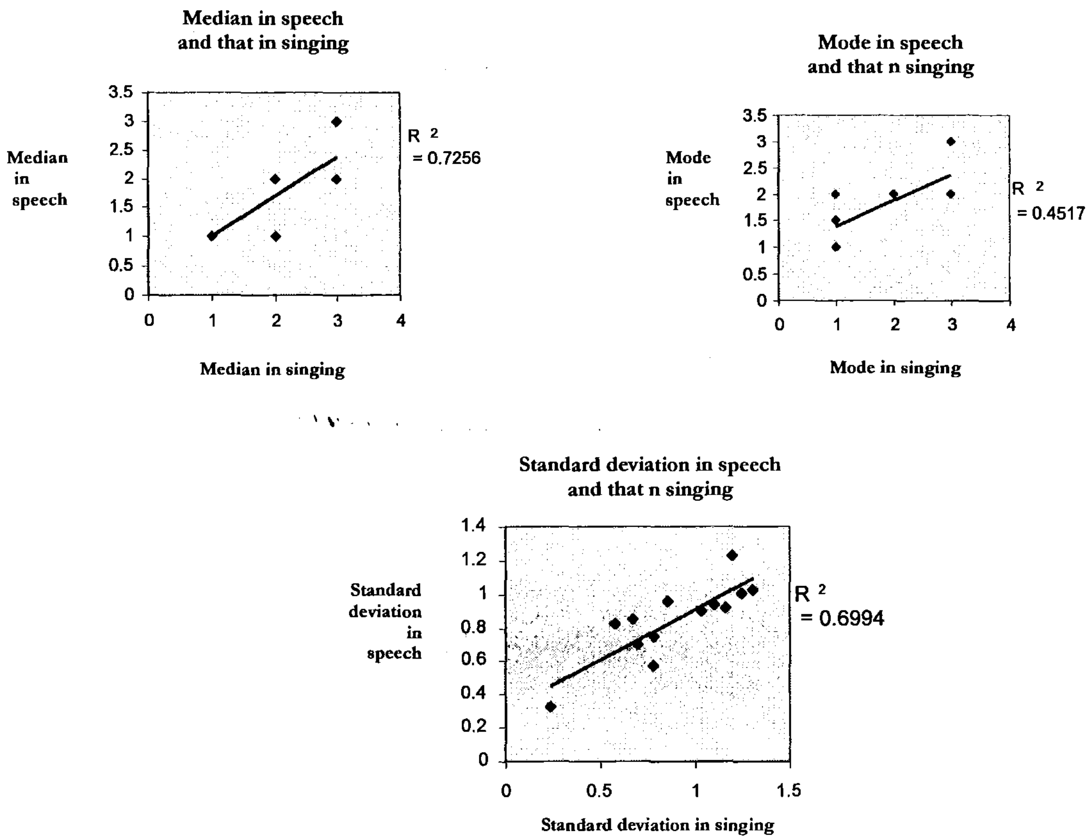


Figure 3.4: Scatterplots for: median for voice quality in speech and in singing for the whole class (left top figure); mode for voice quality in speech and that in singing for the whole class (right top figure); and standard deviation in speech and that in singing (lower figure)

	Speech= mode	Singing= mode	Speech=Std. Deviation	Singing=Std. Deviation	Speech= median	Singing=median
seneness	3.00	3.00	1.195	1.227	3.00	3.00
thiness	3.00	2.00	0.857	0.9581	3.00	2.00
:rfunctional	3.00	2.00	1.162	0.9236	3.00	2.00
)functional	1.00	1.00	0.575	0.8264	1.00	1.500
ngs	1.00	2.00	1.3086	1.0226	1.00	2.00
h	2.00	2.00	1.0369	0.900	2.00	2.00
ks	1.00	1.00	0.7838	0.752	1.00	2.00
able	1.00	1.00	0.6691	0.8498	1.00	1.00
	2.00	1.00	1.0981	0.9376	2.00	2.00
ıl fry	2.00	1.00	1.249	1.00326	2.00	1.00
ble	1.00	1.00	0.6978	0.70479	1.00	1.00
ɜrnasal	1.00	1.00	0.7775	0.5745	1.00	1.00
ɔnasal	1.00	1.00	0.2357	0.32338	2.00	1.00

Table 3.3: Descriptive statistics for separate voice parameters in speech and those in singing

			St.Dev.Speech	St.Dev.Singing
Spearman's rho	St.dev. speech	Correlation Coefficient	1.000	.853(**)
		Sig. (2-tailed)	.	.000
		N	13	13
	St.dev.singing	Correlation Coefficient	.853(**)	1.000
		Sig. (2-tailed)	.000	.
		N	13	13

Table 3.4: Correlation between standard deviation for overall voice quality in speech and standard deviation for overall voice quality in singing

			Median speech	Median singing
Spearman's rho	Median speech	Correlation Coefficient	1.000	.353(**)
		Sig. (2-tailed)	.	.000
		N	13	13
	Median singing	Correlation Coefficient	.353(**)	1.000
		Sig. (2-tailed)	.000	.
		N	13	13

Table 3.5: Correlation between median for overall voice quality in speech and median for overall voice quality in singing

			Mode speech	Mode singing
Spearman's rho	Mode speech	Correlation Coefficient	1.000	.852(**)
		Sig. (2-tailed)	.	.000
		N	13	13
	Mode singing	Correlation Coefficient	.852(**)	1.000
		Sig. (2-tailed)	.000	.
		N	13	13

Table 3.6: Correlation between mode for overall voice quality in speech and mode for overall voice quality in singing

Voice quality ratings for the 13 individual voice parameters in speech were compared to the same parameters in singing for each child. For all the children, the results were not significant ($p>0.05$) (see Table 3.7). The finding suggests that voice quality in the individual voice parameters in speech did not differ significantly from those in singing.

	voicebeh	N	Mean Rank	Sum of Ranks	Mann Whitney U/ Exact significance
sub1	speech	13	14.58	189.50	70.5/ 0.479
	singing	13	12.42	161.50	
	Total	26			
sub2	speech	13	14.08	183.00	77.0/ 0.724
	singing	13	12.92	168.00	
	Total	26			
sub3	speech	13	13.50	175.50	84.5/ 1.00
	singing	13	13.50	175.50	
	Total	26			
sub4	speech	13	14.50	188.50	71.5/ 0.511
	singing	13	12.50	162.50	
	Total	26			
sub5	speech	13	14.35	186.50	73.5/ 0.579
	singing	13	12.65	164.50	
	Total	26			
sub6	speech	13	14.08	183.00	77.0/ 0.725
	singing	13	12.92	168.00	
	Total	26			
sub7	speech	13	12.19	158.50	67.5/ 0.390
	singing	13	14.81	192.50	
	Total	26			
sub8	speech	13	11.46	149.00	58.0/ 0.186
	singing	13	15.54	202.00	
	Total	26			

sub9	speech	13	12.42	161.50	70.5/ 0.479
	singing	13	14.58	189.50	
	Total	26			
sub10	speech	13	16.19	210.50	49.5/ 0.072
	singing	13	10.81	140.50	
	Total	26			
sub11	speech	13	13.73	178.50	81.5/ 0.880
	singing	13	13.27	172.50	
	Total	26			
sub12	speech	13	15.58	202.50	57.5/ 0.169
	singing	13	11.42	148.50	
	Total	26			
sub13	speech	13	15.08	196.00	64.0/ 0.311
	singing	13	11.92	155.00	
	Total	26			
sub14	speech	13	12.58	163.50	72.5/ 0.545
	singing	13	14.42	187.50	
	Total	26			
sub15	speech	13	13.08	170.00	79.00/0.801
	singing	13	13.92	181.00	
	Total	26			
sub16	speech	13	13.12	170.50	79.5/ 0.801
	singing	13	13.88	180.50	
	Total	26			
sub17	speech	13	12.38	161.00	70.00/ 0.479
	singing	13	14.62	190.00	
	Total	26			
sub18	speech	13	16.08	209.00	51.00/ 0.091
	singing	13	10.92	142.00	
	Total	26			

Table 3.7: Relationship between voice quality in speech and voice quality in singing for each child

3.3 General impressions and detail of voice quality

As in the first study, general trends and specific details within the voice quality ratings were explored. Mean ratings of each parameter, general trends within the mean ratings and the distribution of the ratings for each individual child were investigated.

3.4 Voice parameters in speech and singing

In addition to investigating the relationship between the mean ratings (i.e. overall voice quality) in speech and those in singing, non-parametric tests were carried out with individual voice parameters. The correlation between the 13 individual voice parameters in speech and those in singing was calculated for the whole group in order to investigate whether the same results were found through such calculation as with the mean ratings. The hypothesis was that the ratings did not differ significantly. The hypothesis was supported by the finding since the result was not significant (z=1.066, 0.640; n.s.) (see Table 3.8). Such a finding implies that the ratings in speech for the individual voice parameters did not differ significantly from those in singing.

		overall speaking	overall singing
N		18	18
Uniform Parameters(a,b)	Minimum	1.90	2.30
	Maximum	3.90	5.90
Most Extreme Differences	Absolute	.224	.133
	Positive	.035	.243
	Negative	-.114	-.081
Kolmogorov-Smirnov Z		1.002	1.091
Asymp. Sig. (2-tailed)		.343	.232

Table 3.8: Kolmogorov-Smirnov non-parametric test for testing the relationship between voice quality in speech and voice quality in singing when taking all the separate voice parameters into consideration

3.5 Voice parameters and their impact on overall voice quality

The ratings for different voice parameters for individual children were looked at in more detail in order to investigate (i) whether any specific voice parameters seemed to be influencing the overall quality of the children's voice and (ii) whether the means were an appropriate tool in comparing the children's voice quality characteristics in speech to those in singing.

Similarly to the first study, hoarseness was perceived as the unhealthiest voice parameter (that is, it had the highest ratings) in both speech and singing (see Tables 3.9 and 3.10). Breathiness was perceived as unhealthy or less healthy in speech for a number of children (22.4% unhealthy and 44.4% less healthy). Roughness (16.6% unhealthy and 27.7 % less healthy) and hypernasality (16.7% less healthy) were perceived as unhealthier for a subset of the children. Hyponasality was perceived as the healthiest voice quality in both vocal behaviours for all the children (100% healthy). Hypofunction was perceived as healthy for the majority of the children (94.4% healthy). Nevertheless, there were no statistically significant differences between the distributions of the ratings for each of the 13 parameters (Kruskal-Wallis: $z=0.554$; $p>0.05$, n.s).

Voice parameter	Speech	Singing
Hoarse	44.4% less healthy; 33.3% unhealthy	44.4% less healthy; 22.4% unhealthy
Breathy	22.4% less healthy; 44.4% unhealthy	11.1% less healthy, 27.7% unhealthy
Rough	16.6 % less healthy, 27.7% unhealthy	16.6% less healthy, 27.7% unhealthy
Hypernasality	16.7% less healthy	5.5% unhealthy
Hyponasal	100% healthy	100% healthy
Hypofunctional	94.4% healthy	77.8% healthy

Table 3.9: Percentages for unhealthy and healthy voice quality characteristics in speech and in singing for the voice parameters rated as the healthiest and the unhealthiest

When the mean ratings for voice parameters in speech and in singing were rank-ordered, the differences between the ratings in speech and those in singing became more evident (see Table 3.10). The greatest differences between the mean ratings in speech and those in singing were recorded in vocal fry (1.4 points higher in singing than in speech), hypofunction (0.7 points higher in speech than in singing) and gratings (0.9 points higher in singing than in speech). This implies that there may be differences between the voice quality ratings for specific parameters in speech when compared to those in singing. It should be noted that a greater number of voice parameters were rated as unhealthier in singing than in speech (see Table 3.10).

Voice parameter	Mean rating in speech	Mean rating in singing
Hoarse	3.4	2.3
Hyperfunctional	2.9	2.2
Hypernasality	2.9	2.2
Breathy	2.8	2.3
Rough	2.4	2.1
Gratings	2.2	1.9
Hard glottal attack	2.2	1.9
Vocal fry	2.2	1.8
Voice breaks	1.4	1.7
Hypofunctional	1.3	1.7
Audible inhalation	1.4	1.4
Unstable pitch/ quality	1.3	1.6
Hyponasality	1.1	1.1

Table3.10: Rank-ordered mean ratings for individual voice parameters in speech and singing where 1=healthy, 2=healthy, 3=healthy, 4=less healthy, 5=less healthy, 6=unhealthy, 7=extremely unhealthy (colours indicate three broad categories of vocal health, evidence of some vocal problem, or more extreme unhealthy voice use)

The radar-charts below (see Figure 3.5) verify the findings from above. The radars illustrate the mean ratings for each voice parameter and, subsequently, highlight the healthiest and the unhealthiest parameters. The radars illustrate the minimal differences between the mean ratings for the individual voice parameters in both of the vocal behaviours. They also illustrate that there was grater variation amongst the voice quality ratings in speech than those in singing.

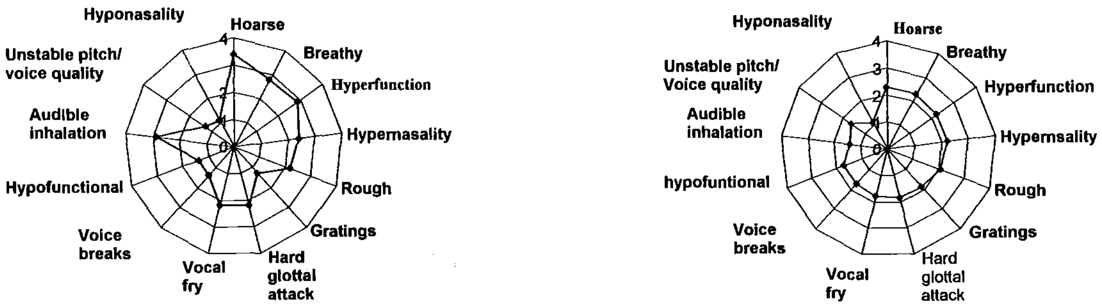


Figure 3.5: Radar-charts for mean ratings in speech (left figure) and those in singing (right figure) for the whole class

3.6 Individual differences

General trends were noted in the class of children in terms of the individual voice parameters that were perceived the healthiest and the unhealthiest. Such characteristics were looked at in more detail in both speech and singing.

3.6.1 Unhealthy characteristics

When looking at the distribution of voice quality ratings for each individual child in terms of their voice quality in speech (see Figure 3.6 and Table 3.11), hoarseness was rated as the unhealthiest quality for 33.3% of the children. Hyperfunctioning was perceived as less healthy quality for 27.8% of the children. Breathy voice quality and voice gratings were perceived as less healthy for 22.2% of the children. Therefore, the ratings for these particular parameters biased the mean ratings of these children's overall voice quality towards unhealthy quality.

When looking at the distribution of the voice quality ratings in singing (see Figure 3.6 and Table 3.11), hoarseness was rated as the unhealthiest quality for 22.2% of the children. Breathy voice quality was perceived as less healthy for 11.1% of the children. Therefore, the ratings for these particular parameters biased the mean ratings for these children's overall voice quality towards healthy.

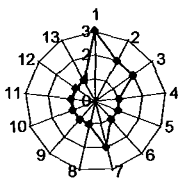
Voice parameter in speech	Rated as healthy voice quality	Rated as less healthy voice quality	Rated as unhealthy voice quality
hoarse	1,2,3,4,5,7,9,11,12,16,17,18	6,8,10,13,14,	15
breathy	1,2,3,4,6,8,9,10,11,12,15,16,17, 18	5,7,13,14	
hyperfunctional	1,2,3,4,6,7,8,9,10,11,16,17,18	5,12,13,14,15	
hypofunctional	1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,16,17,18		
gratings	1,2,3,4,6,8,10,11,12,13,14,16, 17,18	5,7,9,15	
rough	1,2,3,4,6,8,9,10,11,13,14,15,16, 17,18	5,7,12	
voice breaks	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
unstable pitch	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
	1,2,3,4,5,7,8,9,10,11,12,13,14,	6	

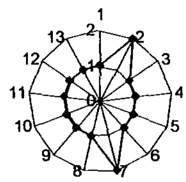
hard glottal attack	15,16,17,18		
vocal fry	1,2,3,4,5,7,8,10,11,12,14,15,16 17,18	6,9,13	
audible inhalation	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
hypernasality	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
hyponasality	1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,16,17,18		
Voice parameter in singing	**Rated as healthy voice quality**	**Rated as less healthy voice quality**	**Rated as unhealthy voice quality**
hoarse	1,2,3,4,5,6,8,10,11,12,15,16,17, 18	7,9,13,14	
Breathy	1,2,3,4,5,6,8,9,10,11,12,13,15, 16,17,18	7,14	
hyperfunctional	1,2,3,4,5,6,7,8,9,10,11,12,13, 14,16,17,18	15	
hypofunctional	1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15,16,17,18		
gratings	voice 15,16,17,18		
rough	1,2,3,4,5,6,8,9,10,11,12,13,14, 15,16,17,18	7	
voice breaks	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
unstable pitch	1,2,3,4,5,6,7,8,9,10,11,12,13,14 15,16,17,18		
hard glottal attack	1,2,3,4,5,7,8,9,10,11,12,13,14, 15,16,17,18	6	
vocal fry	1,2,3,4,5,7,8,9,10,11,12,13,14, 15,16,17,18	6	
audible inhalation	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
hypernasality	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
hyponasality	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		

Table 3.11: Distribution of ratings for separate voice parameters for each individual in speech and in singing (number sin the boxes represent the identification numbers of each individual child)

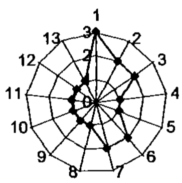
Figure 3.6: Radar-charts for individual children. In all the figures, the following numbering on the outer circle was used to represent the voice parameters: 1= hoarse, 2=breathy, 3=hyperfunction, 4=hypofunction, 5=gratings, 6=rough, 7=voice-breaks, 8=unstable pitch, 9=hard glottal attack, 10= vocal fry, 11=audible inhalation, 12=hypernasality, 13=hyponasality. The numbering on the inner line was sued to represent the scale of the voice ratings. The rating scale consisted of: 1-3= healthy voice quality; 4-5= less healthy voice quality; 6-7= unhealthy voice quality

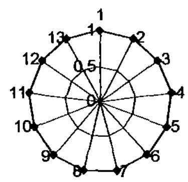
Individual 1: speech (left figure) and singing (right figure)



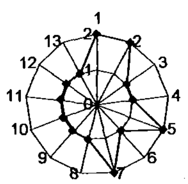


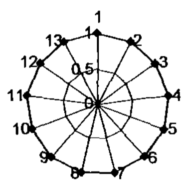
Individual 2: speech (left figure) and singing (right figure)



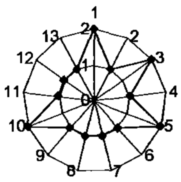


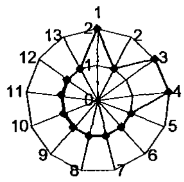
Individual 3: speech (left figure) and singing (right figure)



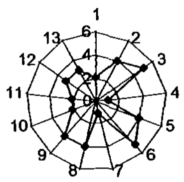


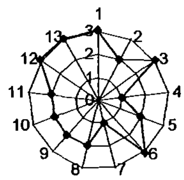
Individual 4: speech (left figure) and singing (right figure)



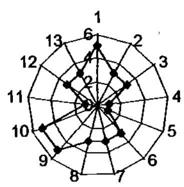


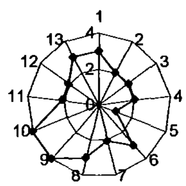
Individual 5: speech (left figure) and singing (right figure)



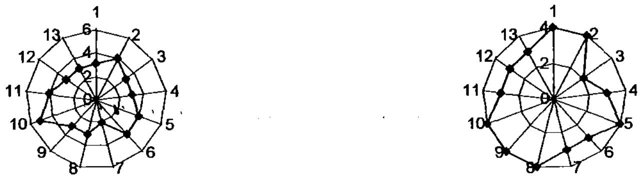


Individual 6: speech (left figure) and singing (right figure)





Individual 7: speech (left figure) and singing (right figure)



Individual 8: speech (left figure) and singing (right figure)

Individual 9: speech (left figure) and singing (right figure)

Individual 10: speech (left figure) and singing (right figure)

Individual 11: speech (left figure) and singing (right figure)

Individual 12: speech (left figure) and singing (right figure)

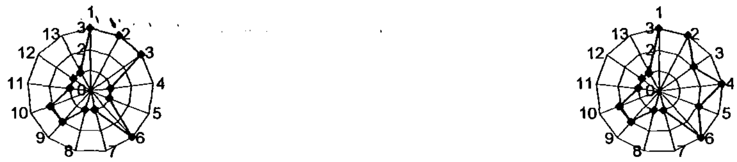
Individual 13: speech (left figure) and singing (right figure)

Individual 14: speech (left figure) and singing (right figure)

Individual 15: speech (left figure) and singing (right figure)

Individual 16: speech (left figure) and sing (right figure)

Individual 17: speech (left figure) and sing (right figure)



Individual 18: speech (left figure) and sing (right figure)

3.6.2 Healthy characteristics

When looking at the distribution of the voice quality ratings in speech for individual voice parameters (see Figure 3.6 and Table 3.11), there were several parameters that were perceived as healthy: These parameters were: hypofunctioning, voice breaks, unstable pitch, audible inhalation, hypernasality and hyponasality. These specific parameters were also perceived as the healthiest ones in singing.

It should be noted that a great number of the mean voice quality ratings for each individual voice parameter fell within the range of 1.0 and 3.0, indicating healthy overall voice quality. A minimal number of the ratings fell within the range of 4.0 and 5.0. A rating of hoarseness in speech for a particular individual fell above 5.0. Such findings indicate that the individual voice parameters rated as the unhealthiest and the healthiest (as indicated above) relatively significantly contributed towards the children's overall voice quality and influenced the listener's general impression of the speaker's voice.

3.7 Relationships between different voice parameters

As in the first study, correlations between individual voice parameters were calculated in order to investigate whether unhealthy voice quality in specific parameters correlated with unhealthy quality in any other specific parameters. Such correlations were calculated between each of the 13 parameters in speech and in singing, separately.

In speech, statistically significant correlations were found between: breathiness and hyperfunctioning ($r=0.788$, $p< 0.01$); breathiness and gratings ($r=0.640$, $p<0.05$); breathiness and roughness ($r=0.803$, $p<0.05$); hyperfunctioning and gratings ($r=0.760$, $p<0.05$); audible inhalation and hypofunctioning ($r=0.888$, $p<0.05$); hyperfunctioning and roughness ($r=0.683$, $p<0.05$); unstable pitch and hard glottal attack ($r=0.562$, $p<0.05$); and hard glottal attack and vocal fry ($r=0.933$, $p<0.05$) (see Figure 3.7 below). The findings imply that there is a connection between the above voice qualities. For example, when a child's voice is perceived as possessing a breathy quality in speech, the child's vocal functioning is likely to be perceived as hyperfunctioning in speaking (and vice versa).

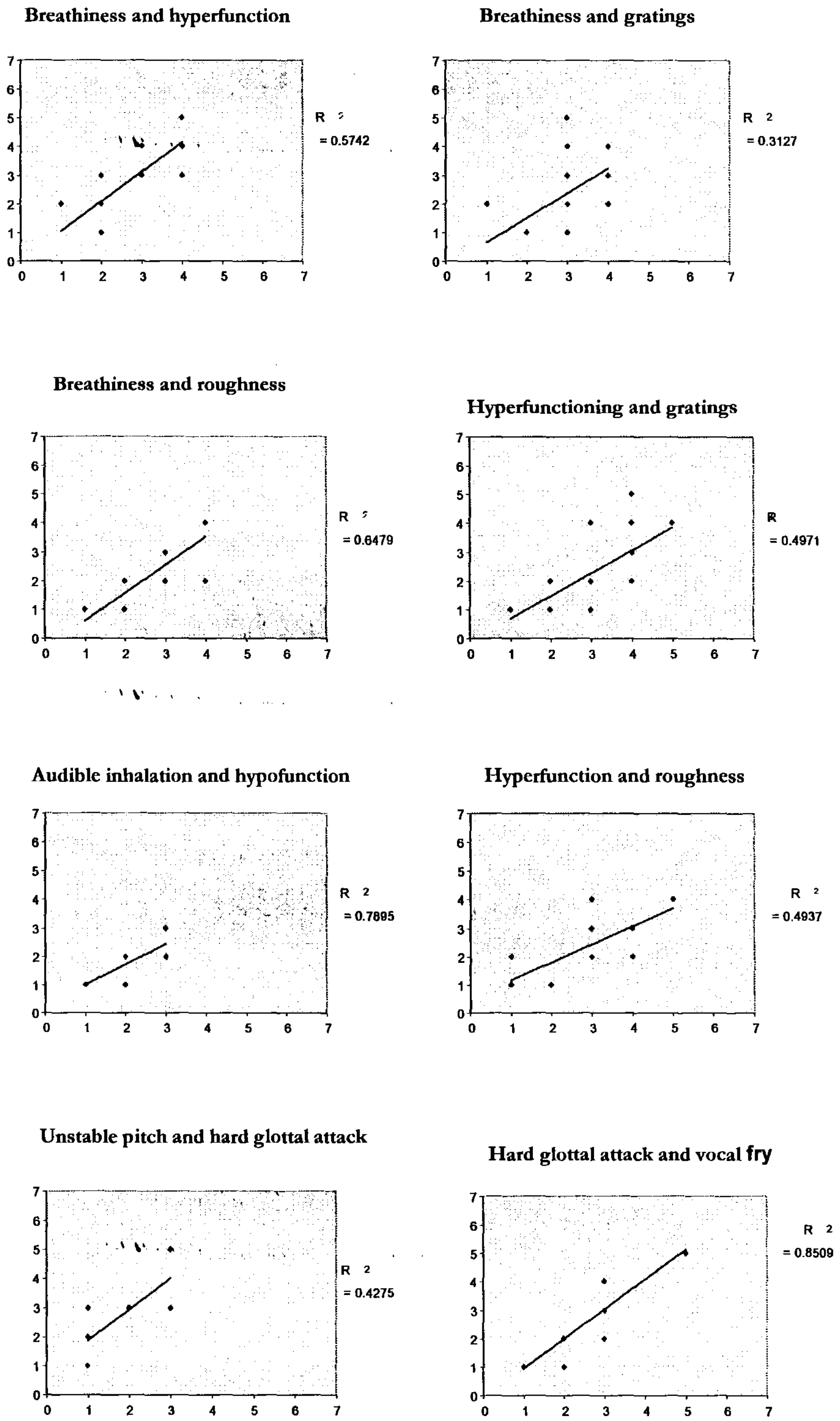


Figure 3.7: Scatterplots for individual voice parameters in speech

In singing, significant correlations were also found between specific parameters. These specific parameters were: hoarseness and breathiness ($r=0.836$, $p< 0.05$); hypofunctioning and roughness ($r=0.639$, $p<0.05$); gratings and roughness ($r=0.674$, $p<0.05$); unstable pitch and hard glottal attack ($r=0.793$, $p<0.05$); unstable pitch and vocal fry ($r=0.781$, $p<0.05$); and hard glottal attack and vocal fry ($r=0.793$, $p<0.05$) (see Figure 3.8). The findings imply that there are connections between these specific voice parameters. For example, when a child's voice is perceived as possessing a horse quality in singing, it is likely to be perceived as possessing a rough quality too (and vice versa).

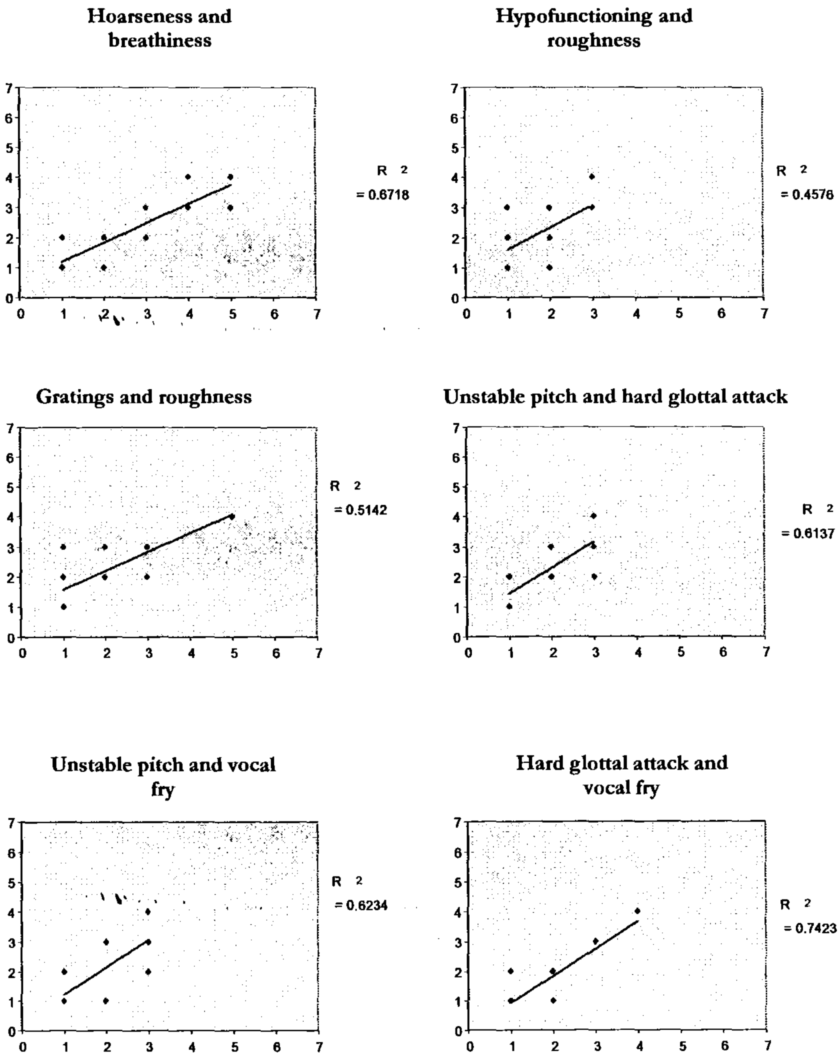


Figure 3.8: Scatterplots between individual voice parameters in singing

3.8 Summary

The children in this particular group generally possessed relatively healthy overall voice quality in both speaking and singing behaviours. For the majority of the children, their voice quality was healthier in singing than in speech. Hoarse, rough, breathy and hyperfunctional qualities were perceived as the unhealthiest ones for a great number of children, biasing their overall voice quality towards unhealthy in both speech and singing. On the contrary, hypofunctioning and hyponasality were perceived as the healthiest parameters for a number of children, biasing their overall voice quality towards healthy in both speech and singing.

3.9 Perceived speaking and singing competencies

The children's speaking and singing competencies were assessed with the use of a specially designed protocol (see Chapter Four and Appendix 1 for more details on the protocol).The data analyses employed in the first study was replicated in the second study (see Section 7.1 for more details on the analyses). The intension was to investigate whether the level of a child's perceived speaking or singing competency had a significant influence on the overall quality of the child's voice.

None of the correlations were statistically significant (perceived speaking competency and overall voice quality in speech: r=-0.184, n.s.; perceived speaking competency and overall voice quality in singing: r=-0.053, n.s.; perceived singing competency and overall voice quality in speech: r=-0.357, n.s.; perceived singing competency and overall voice quality in singing: r=-0.132, n.s.) (see Tables 3.12-3.15 and Figures 3.9-3.12). The findings indicate that the perceived level of a child's speaking or singing competency does not necessarily influence the overall quality of the child's voice in speech nor in singing.

			voice quality in speech in reading	level of speaking competency
Spearman's rho	voice quality in speech	Correlation Coefficient	1.000	-.184
		Sig. (2-tailed)	.	.466
		N	18	18
	level of speaking competency	Correlation Coefficient	-.184	1.000
		Sig. (2-tailed)	.466	.
		N	18	18

Table 3.12: Correlation for perceived speaking competency and overall voice quality in speech

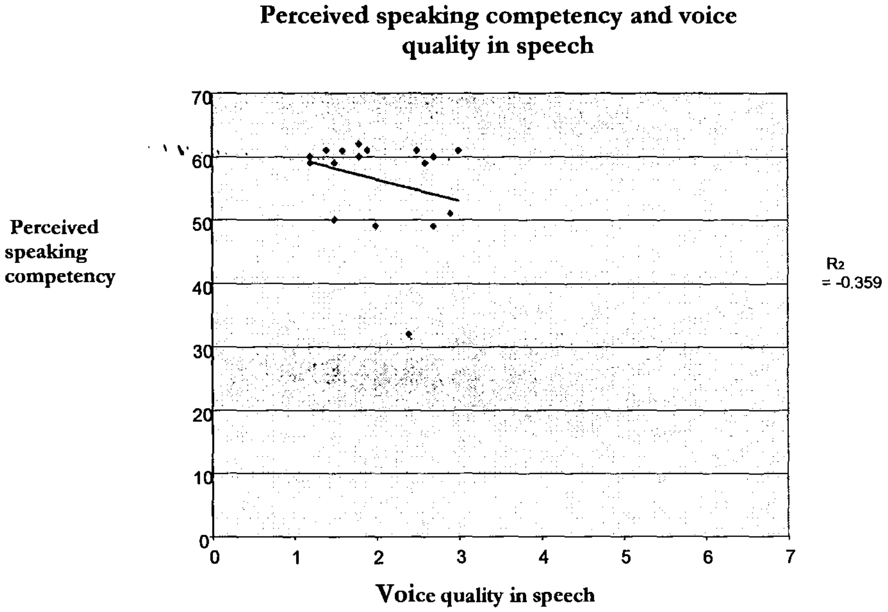


Figure 3.9: Scatterplot for voice quality in speech and speaking competency

			level of speaking competency	voice quality in singing songs
Spearman's rho	level of speaking competency	Correlation Coefficient	1.000	-.053
		Sig. (2-tailed)	.	.833
		N	18	18
	voice quality in singing songs	Correlation Coefficient	-.053	1.000
		Sig. (2-tailed)	.833	.
		N	18	18

Table 3.13: Correlation for perceived speaking competency and overall voice quality in singin

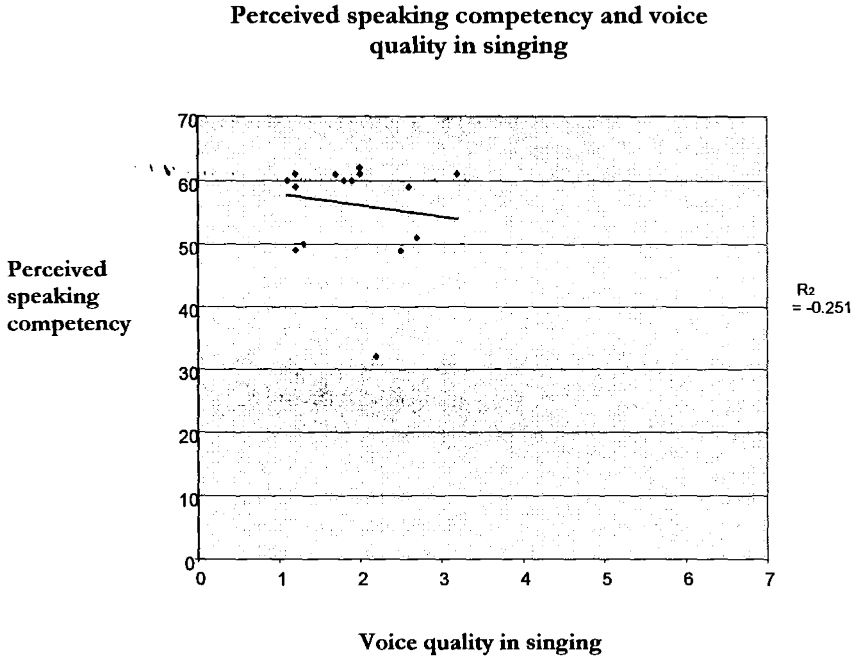


Figure 3.10: Scatterplot for voice quality in singing and speaking competency

			voice quality in singing songs	level of singing competency
Spearman's rho	voice quality in singing	Correlation Coefficient	1.000	-.357
		Sig. (2-tailed)	.	.146
		N	18	18
	level of singing competency	Correlation Coefficient	-.357	1.000
		Sig. (2-tailed)	.146	.
		N	18	18

Table 3.14: Correlation for perceived singing competency and overall voice quality in Singing

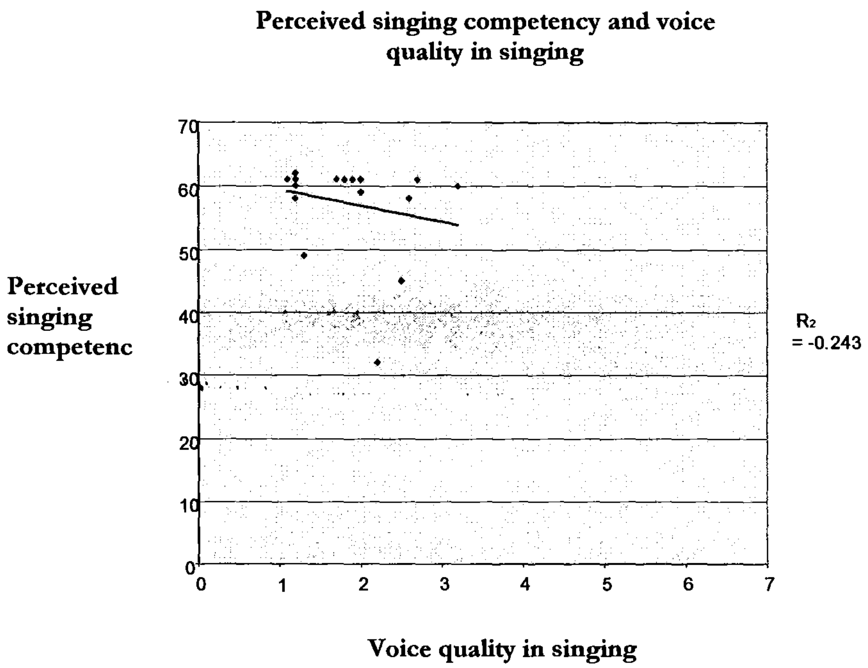


Figure 3.11: Scatterplot for voice quality in singing and singing competency

			level of singing competency	voice quality in speech in reading
Spearman's rho	level of singing competency	Correlation Coefficient	1.000	-.132
		Sig. (2-tailed)	.	.602
		N	18	18
	voice quality in speech	Correlation Coefficient	-.132	1.000
		Sig. (2-tailed)	.602	.
		N	18	18

Table 3.15: Correlation for perceived singing competency and overall voice quality in speech

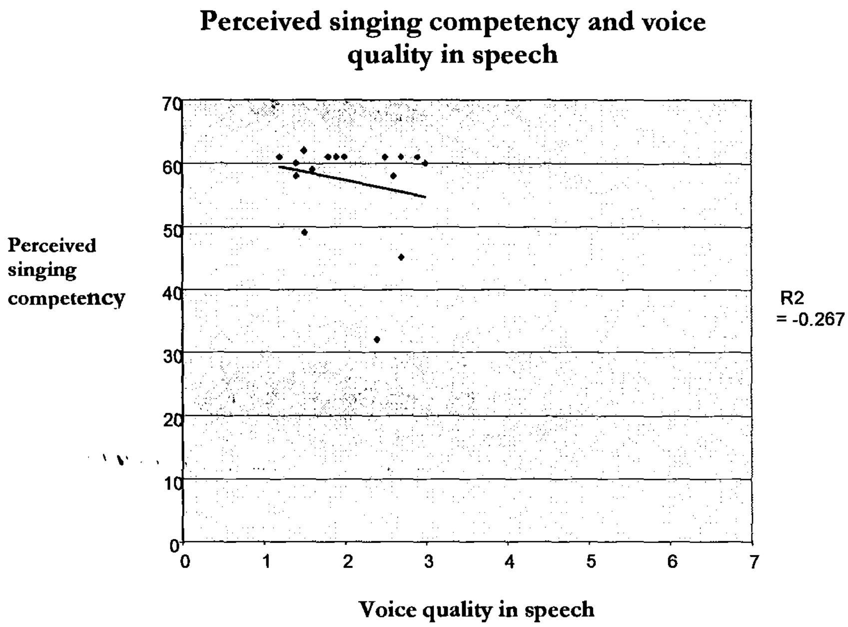


Figure 3.12: Scatterplot for voice quality in speech and singing competency

3.10 Summary

The above findings indicate that the level of a child's perceived speaking or singing competency does not necessarily have a significant effect on the overall quality of the child's voice in speech nor in singing. This indicates that enhanced competency gained through singing training does not necessarily influence the overall quality of children's voice. In other words, refined skill and competency in a particular vocal behaviour does not necessarily result in enhanced vocal functioning or voice quality.

3.11 Psychological factors

Data for psychological factors were analysed as in the first study (see Section 8.3 for more details on the analyses). Similarly to the first study, the data were divided into five categories:

learning and behavioural difficulties; self-esteem and self-worth; personality; vocal identity; and attitude to singing.

3.12 Learning and behavioural difficulties

Three different types of learning and behavioural difficulties were looked at in the analyses. These difficulties were: speaking difficulties, reading difficulties and behavioural difficulties. Data for each were analysed separately.

3.12.1 Speaking difficulty

There was a statistically significant correlation between speaking difficulty and overall voice quality in speech when looking at all the participants as one group ($r= 0.181$; $p< 0.05$) (see Figure 3.13 below and Table 3.16). The correlation was also statistically significant between speaking difficulties and overall voice quality in singing for the whole class ($r=0.287$, n.s.) (see Table 3.17). The findings indicate that the quality of a child's voice in speaking and in singing may have an impact on the child's ability to speak (and vice versa).

The boxplots below illustrate that the children who possessed speaking difficulties exhibited unhealthier overall voice quality in both speech and singing than children without such difficulties did (see Figure 3.13). The boxplots suggest that the children who possessed speaking difficulties exhibited healthier overall voice quality in singing than those children not possessing any speaking difficulties did. The findings indicate that the effect of a child's speaking difficulty on the overall quality of the child's voice may vary depending on the vocal behaviour in question. A further alternative explanation is that there is a third factor (such as the influence of one's family) that is causing the speech and voice distortions to manifest.

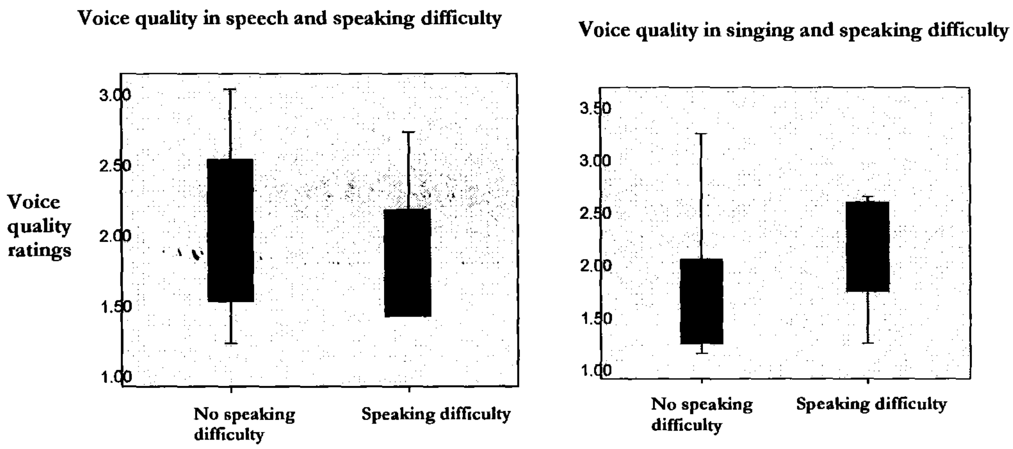


Figure 3.13: Boxplots for the relationship between voice quality in speech and speaking difficulty (left figure), and voice quality in singing and speaking difficulty (right figure)

			speaking difficulty	voice quality in speech in reading
Spearman's rho	speaking difficulty	Correlation Coefficient	1.000	.181
		Sig. (2-tailed)	.	.023
		N	18	18
	voice quality in speech	Correlation Coefficient	.181	1.000
		Sig. (2-tailed)	.023	.
		N	18	18

Table 3.16: Correlation between speaking difficulty and voice quality in speech

			speaking difficulty	voice quality in singing songs
Spearman's rho	speaking difficulty	Correlation Coefficient	1.000	.287
		Sig. (2-tailed)	.	.248
		N	18	18
	voice quality in singing	Correlation Coefficient	.287	1.000
		Sig. (2-tailed)	.248	.
		N	18	18

Table 3.17: Correlation between speaking difficulty and voice quality in singing

3.12.2 Reading difficulty

The main finding was that there was no statistically significant correlation between overall voice quality and reading difficulty. For the whole class, the correlation was not significant between overall voice quality in speech and reading difficulty (r=0.287; n.s.) (see Table 3.18). It was not significant between overall voice quality in singing and reading difficulty either (r=0.404; n.s) (see Table 3.19) (see Figure 3.14 below).

The boxplots below verify the findings (see Figure 3.14). The boxplots illustrate that the overall voice quality of the children possessing reading difficulties was healthier (mode: 1.5) in speech than the overall voice quality of those not possessing any reading difficulties was (mode: 1.8). The same result was found for overall voice quality in singing and reading difficulty (mode: 1.3 versus mode: 1.9). The range of the ratings was wider for the children possessing reading difficulties than for those not possessing reading difficulties. A further alternative explanation is that a third factor (such as school environment) may have caused both the voice distortions and the reading difficulties to manifest.

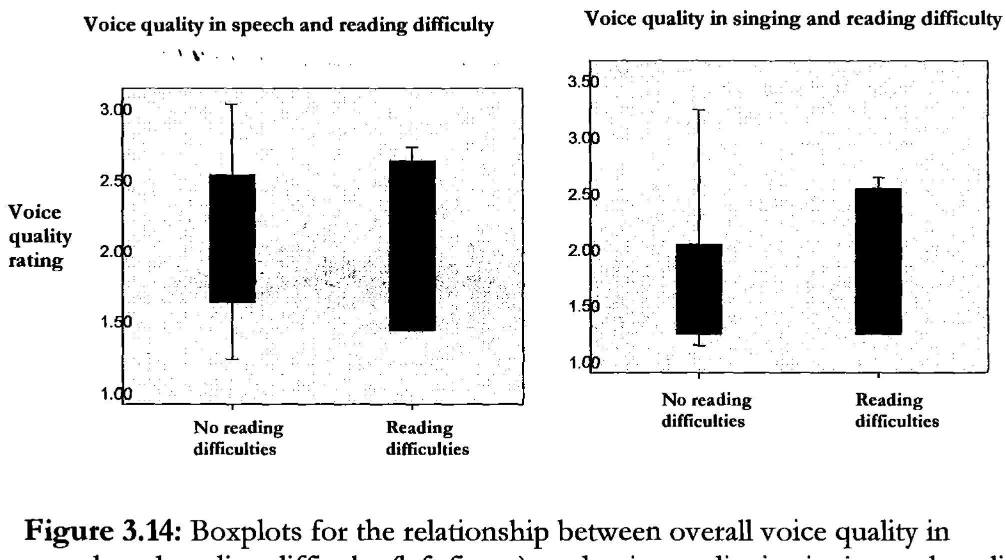


Figure 3.14: Boxplots for the relationship between overall voice quality in speech and reading difficulty (left figure), and voice quality in singing and reading difficulty (right figure)

			reading difficulty	voice quality in speech in reading
Spearman's rho	reading difficulty	Correlation Coefficient	1.000	-.132
		Sig. (2-tailed)	.	.602
		N	18	18
	voice quality in speech	Correlation Coefficient	-.132	1.000
		Sig. (2-tailed)	.602	.
		N	18	18

Table 3.18: Correlation between reading difficulty and voice quality in speech

			reading difficulty	voice quality in singing songs
Spearman's rho	reading difficulty	Correlation Coefficient	1.000	-.036
		Sig. (2-tailed)	.	.886
		N	18	18
	voice quality in singing	Correlation Coefficient	-.036	1.000
		Sig. (2-tailed)	.886	.
		N	18	18

Table 3.19: Correlation between reading difficulty and voice quality in singing

3.12.3 Behavioural difficulties

The main finding was that there was a statistically significant correlation between overall voice quality in speech and behavioural difficulty for the whole class ($r=0.89$; $p<0.05$) (see Table 3.20). The correlation was not significant between overall voice quality in singing and behavioural difficulties ($r=-0.106$; n.s) (see Tables 3.20 and 3.21).

The boxplots below verify the findings (see Figure 3.15). The figure indicates that, with reference to overall voice quality in speech, there was a significant correlation between overall voice quality and behavioural difficulty. With reference to singing, the figure indicates that there was no significant difference between those children possessing behavioural difficulties and those not possessing such difficulties. For both groups (i.e. children possessing behavioural difficulties and those not possessing such difficulties), the range of the voice quality ratings was wider in speech than in singing. As with speech disorder and reading difficulties, further alternative explanation is that a third factor (such as an environmental factor) may have caused both the voice distortions and the behavioural difficulties to manifest.

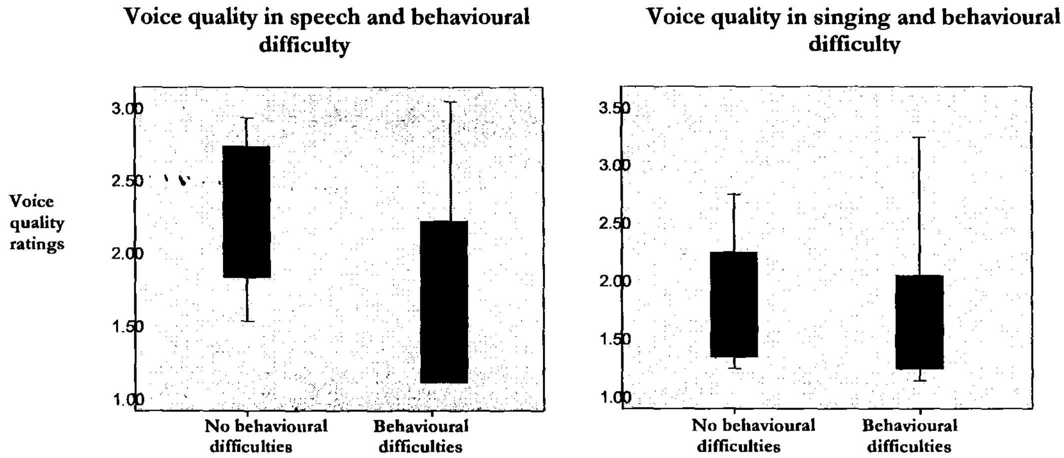


Figure 3.15: Boxplots for the relationship between voice quality in speech and behavioural difficulties (left figure), and voice quality in singing and behavioural difficulties (right figure)

			reading difficulty	voice quality in singing songs
Spearman's rho	behavioural difficulty	Correlation Coefficient	1.000	0.89
		Sig. (2-tailed)	.	.012
		N	18	18
	voice quality in speech	Correlation Coefficient	0.89	1.000
		Sig. (2-tailed)	.012	.
		N	18	18

Table 3.20: Correlation between behavioural difficulty and voice quality in singing

			reading difficulty	voice quality in singing songs
Spearman's rho	behavioural difficulty	Correlation Coefficient	1.000	-.106
		Sig. (2-tailed)	.	.886
		N	18	18
	voice quality in singing	Correlation Coefficient	-.106	1.000
		Sig. (2-tailed)	.886	.
		N	18	18

Table 3.21: Correlation between behavioural difficulty and voice quality in singing

3.13 Vocal identity

Data analyses for vocal identity was analysed the as in the first study (see Section 5.15 for more details on the analyses). The data were analysed qualitatively, with the help of EXCEL-software programme. The class of children were looked at as one group. Since none of the children were perceived as possessing distinctively unhealthy overall voice quality (i.e. ratings between 5-7), children possessing less healthy overall voice quality (i.e. mean rating between 3-4) were compared to those possessing healthier overall voice quality (i.e. mean rating between 1-2).

The first finding was that the majority of the children (n=16) regarded 'speaking' and 'singing' voices as two different entities. As an example, one boy argued:

'Different. Definitely different. My voice is sounds a lot different in speech from singing.'

Eleven of the children stated that different physiological elements generated speech and singing, whilst seven stated that one's voice generated speech and singing. As an example for physiological elements, one girl stated:

'The voice is different when you speak and when you sing... The mouth and tongue and brain and lips make speech happen. The mouth and tongue also make singing happen.'

As an example for the voice as the main instrument, a boy claimed:

'My voice makes my speaking and singing to happen. Without the voice I wouldn't be able to do it.'

Children who possessed less healthy overall voice quality (n=5) stated that the brain and sound generate both speech and singing. As an example, one boy claimed:

'The brain is important. The brain determines many things...'

The second finding was that all of the children (N=18) were able to identify with their voices in both vocal behaviours. More than half the children (N=11) liked the way their voices sounded in both speech and singing. For example, one girl argued:

'Yes (I like the way my voice sounds in speech). It sounds nice. Yes (I like the way my voice sounds in singing). It sounds perfect.'

Five children stated that they liked the way their voices sounded in speech but not in singing. As an example, one boy stated:

'It (own voice in speech) sounds good so I like it. It (own voice in singing) doesn't sound so good so I don't really like it.'

Only one child stated that he liked his voice in singing but not in speech. He claimed:

'I like my voice in singing since it sounds great. I don't like it in speech, because it does not sound so great.'

One child stated that he did not like his voice in speech nor in singing. He stated:

'I don't like the way my voice sounds because it is my voice and I can hear it well when I speak or sing.'

'Singing voice' was viewed in more positively than 'speaking voice' by the majority of the children (n=16). For instance, one boy argued:

'My voice sounds wonderful and perfect when I sing. My voice sounds normal when I speak.'

Another girl claimed:

'My voice sounds good when I speak, but it sounds perfect when I sing.'

Only two of the children stated that their voices sounded 'normal' in speech and singing. For example, a boy stated:

'My voice sounds so beautiful when I sing...My voice sounds fairly normal when I speak, but it is much better in singing than in speech.'

A mixture of responses was received from the children possessing unhealthier overall voice quality. One of them stated that he did not like the way his voice sounded in speech nor in singing. He claimed:

'I don't like to speak or sing because then I can hear my own voice and I don't like it.'

One girl stated that she only liked her voice in singing. She argued:

'I don't like my voice when I speak but my voice sounds beautiful when I sing.'

The rest of these children (n=4) stated that they liked their voices both in speech and singing. For example, one boy claimed:

'I like my voice when I speak and when I sing. It sounds good in speaking and wonderful in singing.'

3.14 Self-esteem and self-worth

Data for the level of the children's self-esteem and self-worth were analysed as in the first study (see Section 8.7 for more details on the analyses). The first finding was that half of the children (n=9) regarded themselves as confident. The majority of the children possessing less healthy overall voice quality (n=5) stated that they did not feel confident (see Table 3.22).

The second finding was that the majority of the children (n=16) held positive biographic perceptions. Children possessing less healthy overall voice quality also held positive biographic perceptions (see Table 3.22).

Characteristic	Whole class (N= 18)	Healthy overall voice quality (N=12)	Unhealthy overall voice quality (N=6)
Confident	50 % (N= 9/ 18)	100% (N= 12/ 12)	16.7% (N= 1/ 6)
Happy	94.4% (N= 17/ 18)	91.7% (N= 11/ 12)	83.3% (N= 5/ 6)
Cheerful	83.3% (N= 15/ 18)	91.7% (N= 11/ 12)	66.7% (N= 4/ 6)
Talkative	66 .7% (N= 12/ 18)	83.3% (N= 10/ 12)	66.7% (N= 4/ 6)
Outgoing	50% (N= 9/ 18)	83.3% (N= 10/ 12)	66.7% (N= 4/ 6)
Worried	11 % (N= 2/ 18)	16.6% (N= 2/ 12)	66.7% (N= 6/7)
Quiet	33.3% (N= 6/ 18)	16.6% (N= 2/ 12)	33% (N= 2/6)
Angry	27.7% (N= 5/ 18)	16.6% (N= 2/ 12)	16.7% (N= 1/ 6)

Table 3.22: Percentages of statements for biographic perceptions

The above finding was supported by evidence gathered for self-efficacy statements. Children with healthy overall voice quality held more positive perceptions of their future than children with unhealthier overall voice quality did (see Table 3.23). The findings, therefore, indicate that children's overall voice quality are connected to their biographic perceptions. It may also be that a third factor (such as one's culture) is equally influencing the children's vocal functioning and voice quality, as well as their biographic perceptions.

Items measuring self-worth / self-esteem	Unhealthy voice quality (scores 5-7) (N= 6)	Healthy voice quality (scores 1-3) (N= 12)
(S)he believes that (s)he would do well in a future event.	33.3% (N= 2/ 6)	83.3% (N= 10/ 12)
(S)he believes that (s)he would be able to engage in any type activity.	37.3% (N= 2/ 6)	83.3% (N= 10/ 12)

Table 3.23: Percentages of statements for self-efficacy statements

3.15 Personality factors

Data for the participant children's personality characteristics were analysed as in the first study (see Section 6.8 for more details on the analyses). The results were analysed according to the guidelines set in the manual for the test.

The first finding was that the majority of the participant children regarded themselves as hyperactive and extraverted (N=16). The second finding was that the majority of the children (n=15) were regarded themselves as obedient and well-behaved. A significant number of the children (n=14) regarded themselves as hyperactive and extraverted. Only four children regarded themselves as shy or introverted (see Table 3.24 below).

Personality characteristic	Percentage of children (N=18)	Healthy voice quality (N=12)	Unhealthy voice quality (N=6)
Hyperactive and Extraverted	77%	49.9%	83.3%
Shy and Introverted	22%	50.1%	16.7%
Obedient and Well-behaved	82.5%	83.3%	83.3%

Table 3.24: Percentages of received personality characteristic statements

3.16 Singing and other musical engagement

Data on the children's singing and other musical engagement were analysed as in the first study (see Section 8.9 for more details on the analyses). The first finding was that, when a child was engaged in singing on a regular basis, (s)he was more likely to be engaged in other musical or performing arts hobbies (see Table 3.7 below). Although the finding indicates a connection between singing activities and other musical hobbies, it should be noted that there may have been external factors (such as their educational opportunities) that contributed to the recorded differences between the children.

All of the children who possessed less healthy overall voice quality (N=7) did not engage in other hobbies that required musical abilities or the use of one's voice; with only two of them reporting to be playing a musical instrument. Such a finding implies that the quality of a child's voice may influence his/ her decision on engaging in other hobbies that rely on voice use (and vice versa) (see Table 3.25 below). Nevertheless, it may also be a third factor (such as a child's socioeconomic background) that determines whether a child pursues hobbies relying on voice use.

Additional hobby	**Engaged in singing** (N= 15)	**Not engaged in singing** (N= 3)	**Healthy voice** (N=11)	**Less healthy voice** (N=7)
Playing of musical instrument(s)	53.3% (N= 8/ 15)	33.3% (N= 1/ 3)	81.8 % (N= 9/ 11)	14.3% (N= 1/ 7)
Other (such as music and movement class or drama)	26.6 % (N= 4/ 15)	0 % (N= 0/ 3)	27.3 % (N= 3/ 11)	0 % (N= 0/ 7)

Table 3.25: Percentages for musical and performing arts hobbies

The second finding was that the children expressed a variety of reasons for being or for not being engaged in singing activities. Those being engaged in singing stated singing as being a fun activity to undertake (n=5). Other reasons for enjoying singing were: singing makes one feel happy; singing makes one feel calm; singing is another way to communicate; and singing lets one's voice go. For example, one boy stated:

'It makes me feel so calm. I feel so good afterwards. My voice just let's itself go.'

Religious background and believes were the main reasons for children not to be willing to engage in singing activities. Other reasons were: not liking one's voice; one's throat hurts when one sings; and singing is a boring activity. For example, one boy stated:

'Singing is just not my thing. It is boring. Also, my throat hurts when I sing.'

The majority of the children (n=4) who possessed less healthy overall voice quality enjoyed singing since they regarded it a fun activity to be engaged in and they stated that they enjoyed the beat of the songs. For instance, one boy claimed:

'The beat of the song makes you feel like doing it for longer and longer.'

Only one child with less healthy overall voice quality stated that singing was boring. She argued:

'It is boring. I don't like any musical things so I don't do any of them.'

3.17 Psychological function and impact of singing

Data for the psychological impact of singing on the children were analysed as in the first study (see Section 8.20 for more details on the analyses). Comparisons were made between children enjoying singing activities and those not enjoying singing activities, as well as between children possessing healthier overall voice quality and children possessing less healthy overall voice quality.

The first finding was that the majority of the children who enjoyed singing (n=7) stated that singing brought them enjoyment and something fun to do. The rest of the children (n=5) who enjoyed singing stated that singing made them feel calm. As an example, one girl stated:

'It makes me feel good. I feel calm and relaxed when I sing.'

The second finding was that the majority of the children who did not enjoy singing (n= 5) stated that they found singing anxiety provoking. The rest of the children (n=3) stated that they did not enjoy singing due to their religion, which did not approve of such activities. As an example, one girl argued:

'It is boring and it makes me feel tense. I don't like the way my voice sounds.'

The third finding was that all of the participant children (N=18) stated that singing was something fun and enjoyable to do. Only one of them stated that it was anxiety provoking. As an example, one boy stated:

'It is so much fun!'

3.18 Summary

The above findings indicate that a number of psychological factors are connected to children's overall vocal functioning and voice quality. Vocal functioning and voice quality seem to be connected to a network of psychological factors that consists of: learning difficulties; reading difficulties; speech difficulties; behavioural difficulties; vocal identity; levels of self-esteem and self-worth; and personality characteristics. Singing has an impact on such a network. Therefore, the findings supported the hypotheses from Study One.

3.19 Sociological factors

The data for sociological factors were analysed as in the first study (see Section 6.21 for more details on the analyses). The findings were divided into three categories. The categories were:

age; siblings; linguistic background; and leisure activities. Sex was eliminated from the analyses since the proportion of boys and girls was not equal, making statistical analyses unfeasible. Socioeconomic background was excluded from the analyses since such information was regarded as too confidential to be used in the study by the head teacher of the school. Age was excluded from the analyses since age-differences in this particular class of children were relatively small and, therefore, statistical analysis was not feasible.

3.20 Linguistic background

There were nine native English speakers and nine non-native English speakers in the class. Two native English-speakers possessed unhealthier overall voice quality in speech than in singing. Only one possessed unhealthier overall voice quality in singing than in speech. Three non-native English-speakers possessed perceived unhealthy overall voice quality (i.e. ratings 5-7) in both speech and in singing. The finding indicates that there were no great differences between non-native and native English-speakers as to their overall voice quality in either vocal behaviour (see Table 3.26 below).

First language	**Unhealthy overall voice quality in speech**	**Unhealthy overall voice quality in singing**
English (N= 9)	11% (N= 1/ 9)	5.5% (N= 1/ 9)
Arabic (N= 4)	50% (N= 2/ 4)	50% (N= 2/ 4)
Somali (N= 4)	50% (N= 2/ 4)	50% (N= 2/ 4)
Other (N= 1)	0% (N- 0/ 4)	0% (N= 0/4)

Table 3.26: Prevalence of unhealthy overall voice quality in speech and in singing for native and non-native English speakers

As with the first study (see Appendix 2), the cultural aspect should be taken into consideration. They may have been accustomed to listening to particular types of voice quality that can be regarded 'normal' in their own culture (such as a degree of nasality in the vocal product). Therefore, they may have judged voice qualities regarded as 'normal' and healthy in other cultures (such as Arabic countries) as 'abnormal' and unhealthy.

3.21 Siblings

In this particular class of children, twelve of the children possessed less than two siblings and seven of the children possessed more than two siblings. Therefore, comparisons were made between these two groups in order to investigate whether the number of siblings had a significant effect on the overall quality of the children's voices.

A greater percentage of children who had more than two siblings possessed unhealthier overall voice quality in both speaking and singing behaviours (see Table 3.27 below). The findings indicate that the number of siblings has a significant impact on the quality of the children's voices.

Number of siblings	Unhealthy Voice Quality in Speech	Unhealthy Voice Quality in Singing
More than two (N =7)	42.9% (N= 3/ 7)	14.3% (N= 1/ 7)
Less than two (N= 12)	24.9% (N= 3/ 12)	8.3% (N= 1/ 12)

Table 3.27: Number of siblings and prevalence of less healthy overall voice quality

The children who were eldest in their families possessed the unhealthiest overall voice quality in speech (see Table 3.28 below). The prevalence of unhealthy overall voice quality in singing was highest for the middle children. The findings indicate that sibling-order may have some effect on the quality of the children's overall voice quality in both vocal behaviours. However, the recorded differences for this particular participant group were relatively minimal. Therefore, firm conclusions cannot be drawn from the study.

Sibling order	Mean rating for voice quality in speech	Mean rating for voice quality in singing
Eldest	2.0 (healthy)	1.8 (healthy)
Youngest or no siblings	1.7 (healthy)	1.5 (healthy)
Middle siblings	1.8 (healthy)	2.1 (healthy)

Table 3.28: Prevalence of unhealthy voice quality characteristics and sibling order

3.22 Leisure activities

The majority of children who possessed unhealthier overall voice quality stated that they enjoyed active hobbies (such as playing in the playground with their friends or going to the park) in their leisure time. Children who possessed healthier overall voice quality enjoyed both and passive hobbies (such as watching TV or playing computer games on their own at home) (see Table 3.29 below). Such findings indicate that children possessing unhealthier overall voice quality may be abusing their voices in their leisure time activities and, therefore, possess unhealthier voice quality.

Group	Active hobbies	Passive hobbies	Mixed hobbies
Children with unhealthy overall voice quality (N=12)	83%.3 (N= 10/ 12)	0% (N= 0/ 12)	16.7% (N= 2/ 12)
Children with healthy overall voice quality (N=6)	33.% (N= 2/ 6)	16.7% (N= 1/ 6)	50.0% (N= 3/ 6)

Table 3.29: Leisure activities and prevalence of voice distortions

3.23 Summary

The findings for the sociological factors can be summarised as:

a) Voice quality in speech and in singing was healthier for native English speakers than for non-native English speakers.

b) In native English speakers, voice quality was healthier in speech than in singing.

c) In non-native English speakers, voice quality was equally healthy in both vocal behaviours.

d) When a child has a greater number of siblings, the worse the overall voice quality of his/ her voice was.

e) Eldest siblings had the unhealthiest overall voice quality in speech. Middle ones and youngest siblings had the unhealthiest overall voice quality in singing.

f) When a child was engaged in active hobbies on a regular basis, his/ her overall voice quality was likely to be unhealthier.

Appendix 4: Third Study

4.1 Introduction and information on participants

The focus of this chapter is data from the third study (Finland, 2006, study 1). The analyses from the previous studies were replicated (see Section 6.1 for more details on the analyses). The participants for the third study (Finland, 2006, study 1) were 22 children from the school located in greater Helsinki area in Finland (see Section 6.9.2 for more information on the participants and the participating schools). As with the previous studies, all 22 children were assessed on the specially designed singing and speaking protocol (see Chapter Five for details on the protocol). The assessment outcome was analysed as in the first study (see Section 6.3 for more details on the analyses). The participants were treated as one group and there were no sub-groups due to the fact that all the children had undergone the same type and amount of formal singing training.

4.2 Overall voice quality in speech and overall voice quality in singing

The descriptive statistics demonstrated that the overall voice quality ratings in speech were similar to the overall voice quality ratings in singing when comparing all the participants as a group between the two vocal behaviours (see Table 4.1 and Figure 4.1). The mean rating for speech was 2.23 compared with 1.88 in singing. The standard deviation was slightly greater for speech than for singing (0.714 versus 0.605). The range for the ratings varied by 2.50 points for speech (1.0-3.5) and by 2.40 for singing (1.2-3.6). Such findings indicate that overall voice quality in speech was unhealthier than overall voice quality in singing for this class of children despite the individual variations between the ratings.

	Speech			Singing		
	Mean	**Standard Deviation**	**Range**	**Mean**	**Standard Deviation**	**Range**
Whole class (n=22)	2.23	0.714	2.50	1.88	0.605	2.40

Table 4.1: Descriptive statistics for voice quality ratings in speech and in singing where 1=healthy, 2=healthy, 3=healthy, 4=less healthy, 5=less healthy, 6=unhealthy, 7=extremely unhealthy (colours indicate three broad categories of vocal health, evidence of some vocal problem, or more extreme unhealthy voice use)

The bar chart below (see Figure 4.1) illustrates that, for the majority of the children, their overall voice quality in speech did not greatly differ from their overall voice quality in singing. For specific individuals (such as individuals 4, 8, 15 and 21), there were noticeable differences, with overall voice quality in singing tending to be healthier than overall voice quality in speech. For 11 children, their overall voice quality was slightly healthier in singing; for six it was slightly healthier in speech; and for two, their voice quality was exactly the same in both speech and singing.

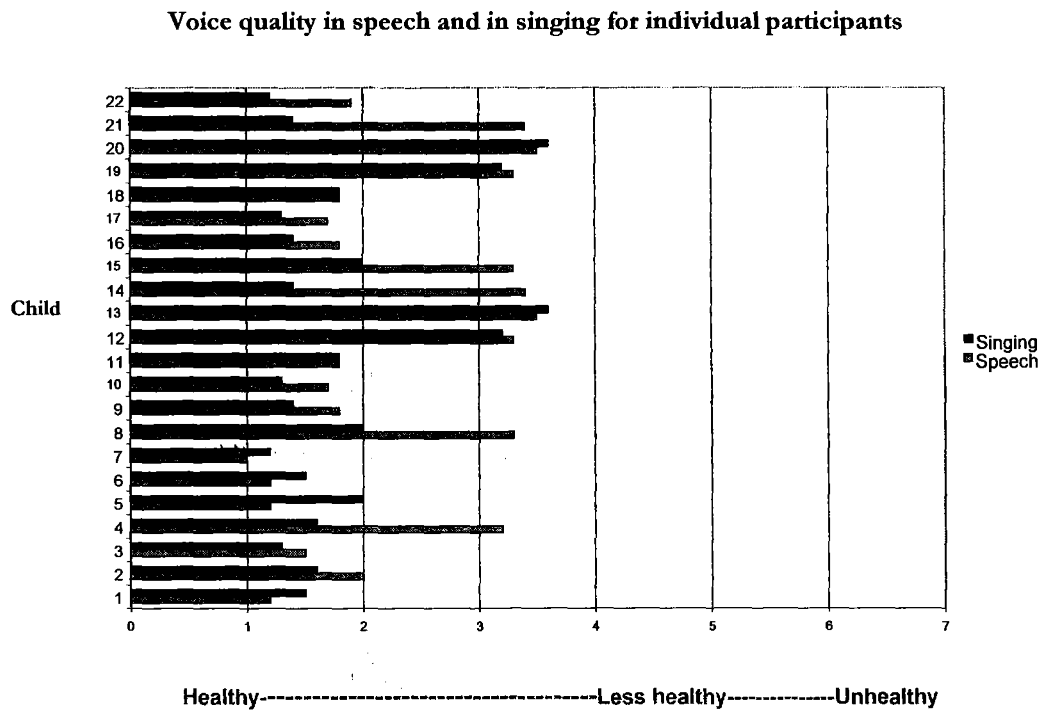
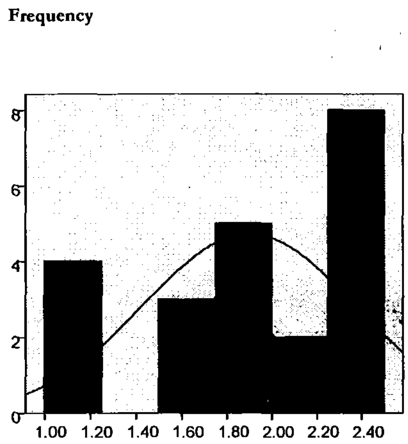


Figure 4.1: Bar chart for overall voice quality ratings in speech and those in singing for individual participants in the class

When the overall voice quality ratings were separately rank-ordered for speech and for singing, the distribution of the ratings in both vocal behaviours were skewed towards healthy overall voice quality (see Figure 4.2 below). For speech, the distribution was positively skewed (skewness distribution: 0.460). The ratings clustered between 1.00 and 2.50, with the highest prevalence being recorded at 2.40. This indicates that the children possessed healthy overall voice quality, with approximately half the children possessing slightly less healthy overall voice quality in speech. For singing, the distribution was also positively skewed (skewness distribution: 1.353), with a greater number of ratings lying below the mean within the range of relatively healthy voice quality. The highest prevalence of ratings was found at the value of 1.70. Although the majority of the ratings clustered between the values of 1.00 and 2.30, there were particular individuals who were rated above 2.50 within the range of less healthy overall voice quality.



Voice quality in speech **Voice quality in singing**

Figure 4.2: Distribution of rank-ordered voice quality ratings in speech (left figure) and in singing (right figure) for the whole class

The scatterplot below (see Figure 4.3) illustrates the correlation between overall voice quality ratings in speech and those in singing for the whole class. The plot indicates a relatively weak positive correlation. This verifies the finding from the non-parametric tests that suggested that there was a tendency for overall voice quality in one vocal behaviour to be associated with similar quality in the other($r=0.519$; $p<0.05$) (see Table 4.2). The plot illustrates that there were no obvious outliers within the voice quality ratings.

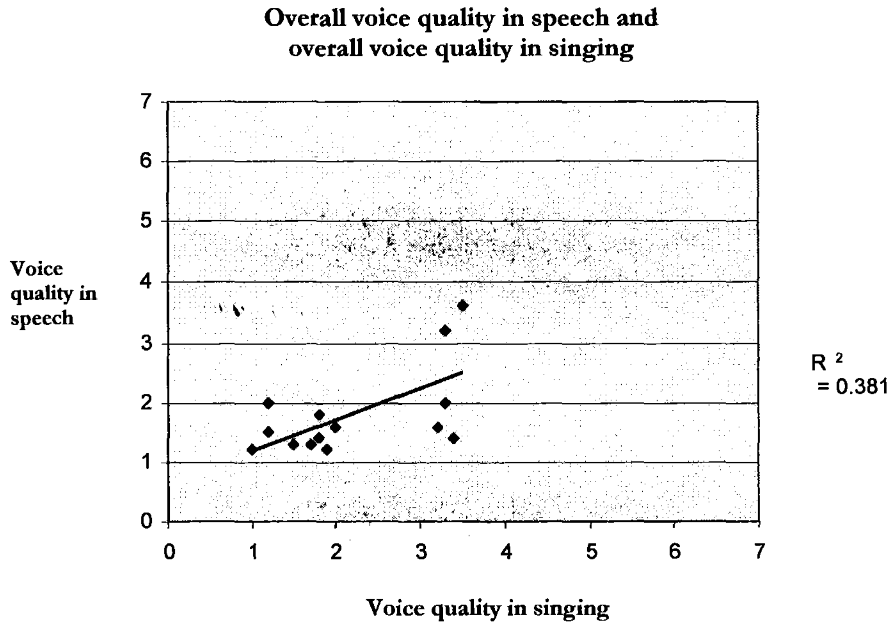


Figure 4.3: Correlation between overall voice quality ratings in speech and those in singing for the whole class

			voice quality in speech	singing a song
Spearman's rho	voice quality in speech	Correlation Coefficient	1.000	.519(*)
		Sig. (2-tailed)	.	.013
		N	22	22
	singing	Correlation Coefficient	.519(*)	1.000
		Sig. (2-tailed)	.013	.
		N	22	22

Table 4.2: Correlation between overall voice quality in speech and overall voice quality in singing

Similarly to the first two studies, the mode, median and standard deviations were calculated for each voice parameter in speech and in singing in order to investigate whether the mean ratings were a reliable tool for representing the data (see Table 4.3-4.6). The finding was that the correlations between each measure in speech and in singing were statistically significant (mode: $r=0.587$; $p<0.05$; median: $r=0.851$; $p<0.05$; standard deviation: $r=0.617$; $p<0.05$) (see Figure 4.4 below). The correlations were positive and fairly strong. Therefore, the mean ratings were regarded as being a reliable tool for representing the voice data.

	Speech= mode	Singing= mode	Speech=Std. Deviation	Singing=Std. Deviation	Speech= median	Singing=media n
hoarseness	3.00	200	1.25	1.5	3.00	2.00
breathiness	2.00	2.00	1.04	1.52	200	100
hyperfunctional	2.00	2.00	1.4	1.17	200	100
hypofunctional	2.00	1.5	0.81	1.50	200	1.00
gratings	2.00	1.00	1.47	1.08	1.00	1.00
rough	2.00	1.5	1.21	0.79	1.00	1.00
breaks	1.00	1.5	0.67	1.25	1.00	1.00
unstable	1.00	1.00	0.35	1.75	1.00	1.00
hard	1.00	1.00	0.80	1.51	1.00	1.00
vocal fry	1.50	1.00	1.25	0.85	100	1.00
audible	1.00	1.00	1.05	0.59	1.00	1.00
hypernasal	1.00	1.00	0.80	0.60	1.00	1.00
hyponasal	2.00	2.00	0.91	0.72	2.00	1.00

Table 4.3: Descriptive statistics for separate voice parameters in speech and in singing

			St.dev.spee ch	St.dev.singi ng
Spearman's rho	St.dev. speech	Correlation Coefficient	1.000	-.209
		Sig. (2-tailed)	.	.493
		N	13	13
	St.dev.singi ng	Correlation Coefficient	-.209	1.000
		Sig. (2-tailed)	.493	.
		N	13	13

Table 4.4: Correlation between standard deviation in speech and standard deviation in singing

			Median speech	Median singing
Spearman's rho	Median speech	Correlation Coefficient	1.000	.721(**)
		Sig. (2-tailed)	.	.005
		N	13	13
	Median singing	Correlation Coefficient	.721(**)	1.000
		Sig. (2-tailed)	.005	.
		N	13	13

Table 4.5: Correlation between median in speech and median in singing

			Mode speech	Mode singing
Spearman's rho	Mode speech	Correlation Coefficient	1.000	.537
		Sig. (2-tailed)	.	.058
		N	13	13
	Mode singing	Correlation Coefficient	.537	1.000
		Sig. (2-tailed)	.058	.
		N	13	13

Table 4.6: Correlation between mode in speech and mode in singing

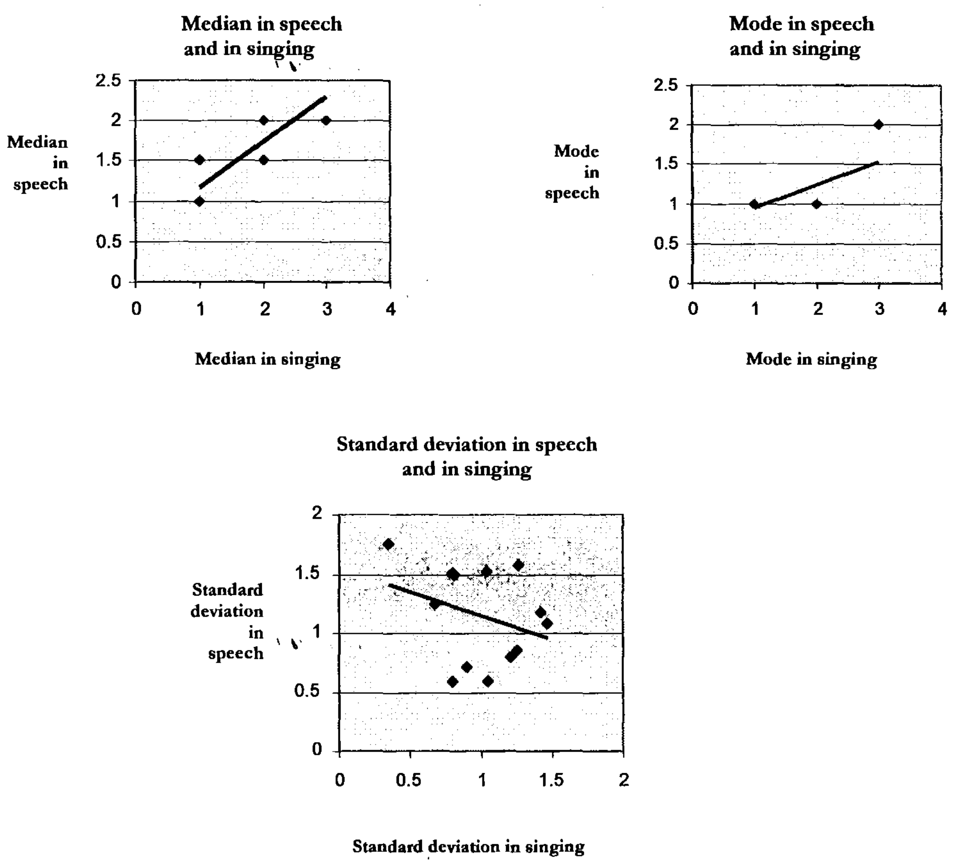


Figure 4.4: Scatterplots for: median for overall voice quality in speech and that in singing for the whole class (left top figure); mode for voice quality in speech and that in singing for the whole class (right top figure); and standard deviation in speech and in singing (lower figure)

The quality of individual voice parameters in speech were compared to those in singing for each child. The hypothesis was that the ratings for the parameters did not differ significantly between the vocal behaviours. For the majority of the children (n=20), the hypothesis was supported since the results were not statistically significant (see Table 4.7). Such a finding suggests that these particular children's voice quality in speech did not differ significantly from that in singing. There were only two individuals (individuals 14 and 21) for whom the test was significant ($z=-44.5$, $p<0.05$; $z= 35.00$, $p<0.05$). Both of the children possessed healthier overall voice quality in speech than in singing (individual 14: mean ratings in speech 1.2 and in singing 2.0; individual 21: mean rating in speech 2.30 and in singing 3.20). Such a finding indicates that, although the general trend was for the voice quality to be similar in the two vocal behaviours, individual differences can be recorded.

	voicebeh	N	Mean Rank	Sum of Ranks	Mann Whitney U/ Exact. Sig.
sb1	speech	13	12.35	160.50	69.05/.448
	singing	13	14.65	190.50	
	Total	26			
sb2	speech	13	14.15	184.00	76.00/.687
	singing	13	12.85	167.00	
	Total	26			
sb3	speech	13	14.42	187.50	72.50/.545
	singing	13	12.58	163.50	
	Total	26			
sb4	speech	13	15.04	195.50	64.50/.311
	singing	13	11.96	155.50	
	Total	26			
sb5	speech	13	12.77	166.00	75.00/.650
	singing	13	14.23	185.00	
	Total	26			
sb6	speech	13	13.42	174.50	83.00/ .960
	singing	13	13.58	176.50	
	Total	26			
sb7	speech	13	13.46	175.00	84.00/1.00
	singing	13	13.54	176.00	
	Total	26			
sb8	speech	13	14.38	187.00	73.00/.579
	singing	13	12.62	164.00	
	Total	26			
sb9	speech	13	15.58	202.50	57.50/.169
	singing	13	11.42	148.50	
	Total	26			
sb10	speech	13	15.23	198.00	62.00/.264
	singing	13	11.77	153.00	
	Total	26			
sb11	speech	13	12.92	168.00	77.00/.724
	singing	13	14.08	183.00	
	Total	26			
sb12	speech	13	11.81	153.50	62.50/.264
	singing	13	15.19	197.50	
	Total	26			
sb13	speech	13	10.96	142.50	51.50/.091
	singing	13	16.04	208.50	
	Total	26			
sb14	speech	13	16.58	215.50	44.50/0.039
	singing	13	10.42	135.50	
	Total	26			
sb15	speech	13	14.73	191.50	68.50/.418
	singing	13	12.27	159.50	
	Total	26			
sb16	speech	13	14.12	183.50	76.50/.687
	singing	13	12.88	167.50	
	Total	26			

sb17	speech	13	14.54	189.00	71.00/.511
	singing	13	12.46	162.00	
	Total	26			
sb18	speech	13	13.81	179.50	80.50/.840
	singing	13	13.19	171.50	
	Total	26			
sb19	speech	13	11.42	148.50	57.50/.169
	singing	13	15.58	202.50	
	Total	26			
sb20	speech	13	11.65	151.50	60.50/.223
	singing	13	15.35	199.50	
	Total	26			
sb21	speech	13	17.31	225.00	35.00/.010
	singing	13	9.69	126.00	
	Total	26			
sb22	speech	13	14.81	192.50	67.50/.390
	singing	13	12.19	158.50	
	Total	26			

Table 4.6: Relationship between voice quality in speech and voice quality in singing for each child

4.3 General impression and detail of voice quality

As in the previous studies, general trends and more specific details within the voice quality ratings were investigated. Mean ratings of each individual voice parameter, general trends within such mean ratings and the distributions of the mean ratings for each participant were explored.

4.4 Voice parameters in speech and those in singing

In addition to investigating the relationship between the mean ratings (i.e. overall voice quality) in speech and those in singing, non-parametric tests were carried out with individual voice parameters. The correlation between the 13 individual voice parameters in speech and those in singing was calculated for the whole group in order to investigate whether the same results were found through such calculation as with the mean ratings. The hypothesis was that the ratings did not differ significantly. The hypothesis was supported by the findings since the result was not significant (z=1.002, 1.034; n.s.) (see Table 4.7), suggesting that the ratings did not differ significantly from each other. Such a finding indicates that the quality in one vocal behaviour tends to be similar in the other.

		overall speaking	overall singing
N		22	22
Uniform Parameters(a,b)	Minimum	1.00	1.20
	Maximum	3.30	3.60
Most Extreme Differences	Absolute	.224	.133
	Positive	.035	.243
	Negative	-.114	-.081
Kolmogorov-Smirnov Z		1.002	1.035
Asymp. Sig. (2-tailed)		.231	.123

Table 4.7: Kolmogorov-Smirnov non-parametric test for testing the relationship between voice quality in speech and voice quality in singing when taking all the separate voice parameters into consideration

4.5 Individual voice parameters and their impact on overall voice quality

The ratings for individual voice parameters for the group of participants were looked at in more detail in order to investigate (i) whether any specific voice parameters seemed to be influencing the overall voice quality of the children's voices and (ii) whether the means were an appropriate tool in comparing the children's voice quality characteristics in speech to those in singing.

Similarly to the first study, hoarseness was perceived as the unhealthiest voice quality (that is, it had the highest ratings) in both speech and singing (see Tables 4.8-4.9). Hyperfunction obtained the same rating as hoarseness in speech but not in singing. Breathiness was also perceived as unhealthier than the majority of the other voice parameters. Voice breaks, unstable pitch and hyponasality were perceived as the healthiest voice parameters. However, it should be noted that there were no statistically significant differences between the distributions of the ratings for the 13 individual parameters (Kruskal-Wallis: $z=0.434$; $p>0.05$, n.s.).

Voice parameter	Speech	Singing
Hoarse	63.6 % less healthy	45.5 % less healthy
Hyperfunctional	45.5% less healthy	31.8% less healthy
Breathy	27.3% less healthy	31.8% less healthy
Voice breaks	90.9% healthy	81.8% healthy
Unstable pitch/ quality	100% healthy	68.1% healthy
Hyponasality	90.9%	86.3%

Table 4.8: Percentages for unhealthy and healthy voice quality characteristics in speech and those in singing for the individual voice parameters that were rated as the healthiest and the unhealthiest

When the mean ratings for each voice parameter in speech and in singing were rank-ordered, the differences between mean ratings in the two vocal behaviours became more evident (see Table 4.9). For five parameters (hypernasality, roughness, vocal fry, voice breaks, hypofunctioning), the ratings were higher in singing than in speech. For seven parameters (hoarse, hyperfunctional, breathy, gratings, hard glottal attack, audible inhalation, hyponasality), the ratings were higher in speech than in singing. For one parameters (unstable pitch), the ratings were the same in both vocal behaviours. The greatest differences between the mean rating in speech and those in singing were recorded in voice breaks (1.0 points higher in singing than in speech) and hyperfuntion (0.7 pints higher in speech than in singing).

Voice parameter	Mean rating in speech	Mean rating in singing
Hoarse	2.9	2.9
Hyperfunctional	2.9	2.2
Breathy	2.7	2.1
Hypernasality	2.1	2.3
Gratings	2.4	1.7
Hard glottal attack	2.1	1.7
Rough	1.8	2.1
Audible inhalation	2.0	1.6
Vocal fry	1.5	2.0
Voice breaks	1.1	2.1
Hypofunctional	1.5	1.8
Hyponasality	1.5	1.4
Unstable pitch/ quality	1.4	1.4

Table 4.9: Rank-ordered mean ratings for voice parameters where 1=healthy, 2=healthy, 3=healthy, 4=less healthy, 5=less healthy, 6=unhealthy, 7=extremely unhealthy (colours indicate three broad categories of vocal health, evidence of some vocal problem, or more extreme unhealthy voice use)

The radar-charts below (see Figure 4.5) verify the findings from the Tables above. The radars illustrate the mean ratings for each voice parameter and, subsequently, highlight the healthiest and the unhealthiest parameters. The radars illustrate the minimal differences between the mean ratings for the individual voice parameters in both of the vocal behaviours. They also illustrate that there was grater variation amongst the voice quality ratings in speech than those in singing.

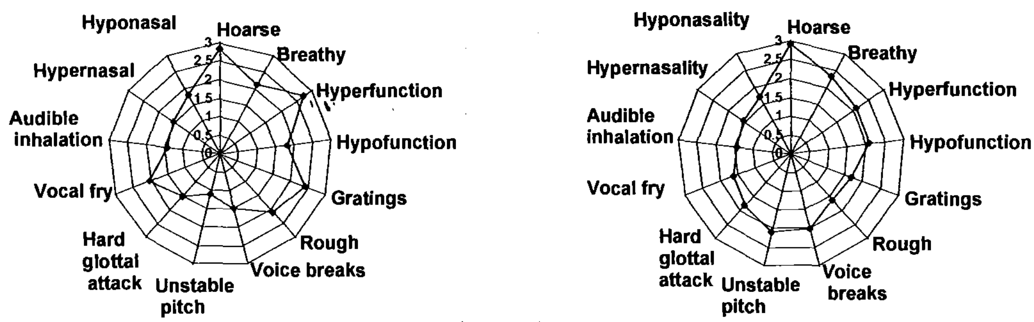


Figure 4.5: Radar-figures of mean ratings for individual voice parameters in speech (left figure) and those in singing (right figure) for the whole class

4.6 Individual differences

General trends were noted in the class of children in terms of the individual voice parameters that were perceived the healthiest and the unhealthiest. Such characteristics were looked at in more detail in both speech and singing.

4.6.1 Unhealthy characteristics

When looking at the distribution of the voice quality ratings in speech for each individual child (see Figure 4.6 and Table 4.10), hoarseness was perceived as the unhealthiest voice quality for 63.6 % of the children. Hyperfunction was perceived as unhealthy for 45.5 % of the children. Breathiness was perceived as unhealthy for 27.3 % of the children. Therefore, the ratings for these particular voice parameters biased the mean ratings representing these children's overall voice quality towards unhealthy in speech.

When looking at the distribution of the ratings in singing (see Figure 4.6 and Table 4.10), hoarseness was rated as the unhealthiest quality for 45.5% of the children. Hyperfunction and breathiness were perceived as unhealthy for 31.8 % of the children. Therefore, the ratings for these particular voice parameters biased the mean ratings of these children's overall voice quality towards unhealthy in singing.

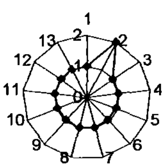
Voice parameter in speech	Rated as healthy voice quality	Rated as less healthy voice quality	Rated as unhealthy voice quality
hoarse	1,2,3,4,5,6,7,9,10,11,14,16,17, 18,21,22	8,12,13,15,19,20	
breathy	1,2,3,4,5,6,7,9,1,0,11,12,13,14, 16,17,18,19,20,21,22	8,15	
hyperfunctional	1,2,3,4,5,7,8,9,10,14,16,17,21,22	6,11,12,13,15,18,19,20	
hypofunctional	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,20,21,22	19	
gratings	1,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19	2,20,21,22	
rough	1,2,3,5,6,7,8,9,10,11,12,13,15, 16,17,18,19,20,21,22	4,14	
voice breaks	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22		
unstable pitch	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22		
hard glottal attack	1,2,3,5,6,7,8,9,10,11,12,13,14,15, 16,17,18,19,20,21,22	4	
vocal fry	1,5,6,7,9,10,11,12,13,14,15,16, 17,18,19,20,21,22	2,3,4,8	
audible inhalation	1,2,3,4,5,6,7,8,9,10,11,12,13,16, 17,18,19,20,21,22	14,15	
hypernasality	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22		
hyponasality	1,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22	2	
Voice parameter in singing	**Rated as healthy voice quality**	**Rated as less healthy voice quality**	**Rated as unhealthy voice quality**
hoarse	1,2,4,6,7,9,10,13,14,16,17,21,22	3,5,8,11,12,15,18,19,20	
breathy	1,2,3,4,5,6,7,8,9,10,11,14,16,17, 18,21,22	12,13,15,19,20	
hyperfunctional	1,2,3,4,5,6,7,8,9,10,11,14,15,16, 17,18,21,22	12,13,19,20	
	1,2,3,4,5,6,7,8,9,10,11,14,15,16,	12,13,19,20	

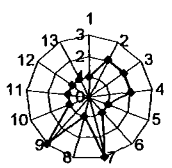
hypofunctional	17,18,21,22		
gratings	1,2,3,4,6,7,8,9,10,11,13,14,15, 16,17,18,19,20,21,22	5,12	
rough	1,2,3,4,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22	5	
voice breaks	1,2,3,5,8,9,10,11,13,14,15,16,17, 18,19,20,21,22	4,6,7,12	
unstable pitch	1,3,5,6,7,8,9,10,11,14,15,16,17, 18,21,22	2,4,12,13,19,20	
hard glottal attack	1,2,3,4,5,7,8,9,10,11,12,14,15,, 1617,18,21,22	6,13,19,20	
vocal fry	1,2,3,4,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22	5	
audible inhalation	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22		
hypernasality	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22		
hyponasality	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22		

Table 4.10: Distribution of ratings for separate voice parameters for individual children in speech and in singing (numbers in the boxes represent the identification numbers of each individual child)

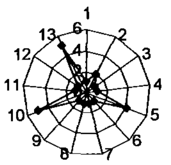
Figure 4.6: Radar-charts for individual children. In all the figures, the following numbering on the outer circle was used to represent the following voice parameters: 1= hoarse, 2=breathy, 3=hyperfunction, 4=hypofunction, 5=gratings, 6=rough, 7=voice-breaks, 8=unstable pitch, 9=hard glottal attack, 10= vocal fry, 11=audible inhalation, 12=hypernasality, 13=hyponasality. The numbering on the inner line was used to represent the scale of the voice ratings. The scale ranged from: 1-3= healthy voice quality; 4-5= less healthy voice quality; 6-7= unhealthy voice quality.

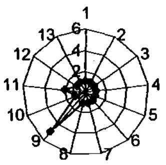
Individual 1: speech (left figure) and singing (right figure)



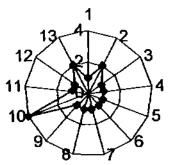


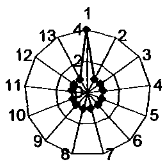
Individual 2: speech (left figure) and singing (right figure)



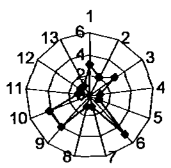


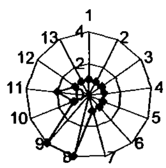
Individual 3: speech (left figure) and singing (right figure)



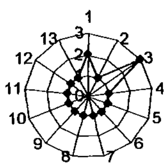


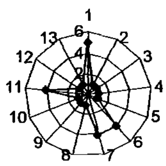
Individual 4: speech (left figure) and singing (right figure)



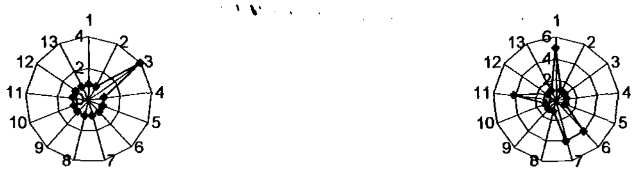


Individual 5: speech (left figure) and singing (right figure)

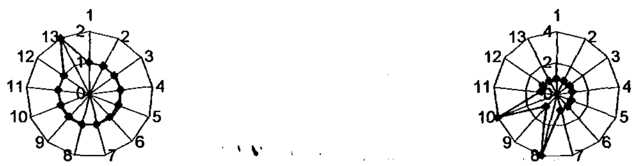




Individual 6: speech (left figure) and singing (right figure)

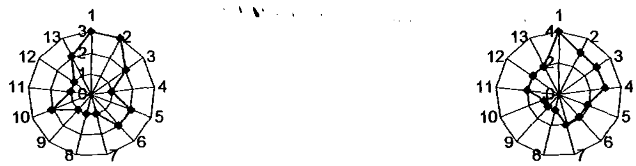


Individual 7: speech (left figure) and singing (right figure)



Individual 8: speech (left figure) and singing (right figure)

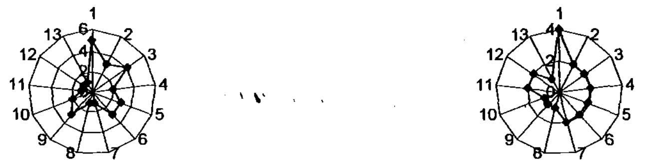
Individual 9: speech (left figure) and singing (right figure)



Individual 10: speech (left figure) and singing (right figure)

Individual 11: speech (left figure) and singing (right figure)

Individual 12: speech (left figure) and singing (right figure)

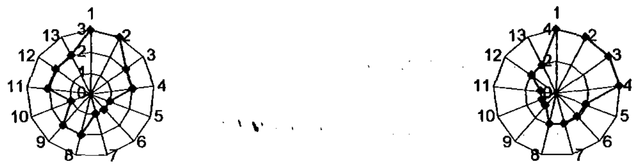


Individual 13: speech (left figure) and singing (right figure)

Individual 14: speech (left figure) and singing (right figure)

Individual 15: speech (left figure) and singing (right figure)

Individual 16: speech (left figure) and singing (right figure)

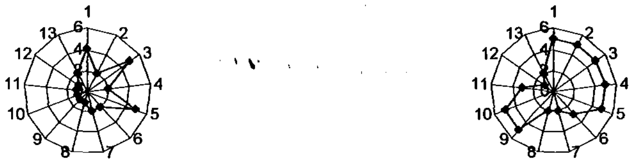


Individual 17: speech (left figure) and singing (right figure)

Individual 18: speech (left figure) and singing (right figure)

Individual 19: speech (left figure) and singing (right figure)

Individual 20: speech (left figure) and singing (right figure)



Individual 21: speech (left figure) and singing (right figure)

Individual 22: speech (left figure) and singing (right figure)

4.6.2 Healthy characteristics

When looking at the distribution of the ratings for individual voice parameters in speech (see Table 4.10 below and Figure 4.6 above), unstable pitch was perceived as the healthiest voice parameters for all of the children. Voice breaks and hyponasality were perceived as healthy for 90.9 % of the children. Therefore, the ratings for these particular parameters biased these children's overall voice quality towards healthy in speech.

It should be noted that a great number of the mean ratings for the individual voice parameters fell within the range of 1.0 and 3.0 in both vocal behaviours, indicating healthy overall voice quality. A subset of the ratings fell within the range 4.0 and 5.0. For one individual, the rating for breathiness fell above 5.0 in both vocal behaviours. Such findings indicate that voice parameters rated as the unhealthiest and the healthiest ones (as indicated above) significantly contributed towards the overall quality of the children's voices and had an impact on the listener's general impression of the speaker's voice.

4.7 Relationships between different voice parameters

As in the first two studies, correlations between individual voice parameters were calculated in order to investigate whether unhealthy voice quality in specific parameters was likely to correlate with unhealthy quality in any other specific parameters. Such correlations were calculated between each of the 13 parameters in speech and in singing, separately.

In speech, a statistically significant correlation was found between roughness and hard glottal attack ($r=0.533$, $p<0.05$) (see Figure 4.7). This implies that when a child's voice was rough in speech, the child was likely to exhibit hard glottal attacks in speaking.

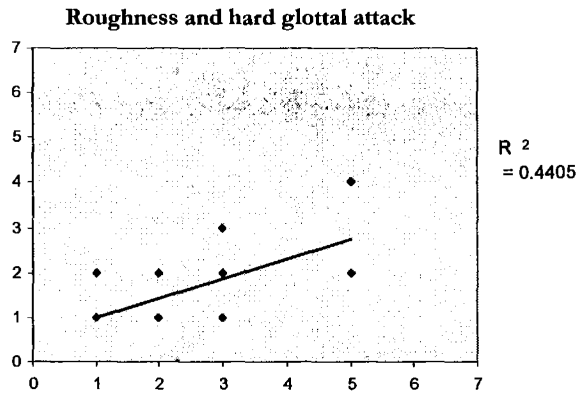


Figure 4.7: Scatterplot for rough voice quality and hard glottal attack in speech

In singing, statistically significant correlations were found between: hoarseness and hyperfunctioning ($r=0.722$, $p<0.05$); hoarseness and hypofunctioning ($r=0.704$, $p<0.05$); hoarseness and gratings ($r=0.833$, $p<0.05$); breathiness and hyperfunctioning ($r=0.855$, $p< 0.05$); breathiness and hypofunctioning ($r=0.740$, $p< 0.05$); hyperfunctioning and hypofunctioning (r=0.860, p<0.05); and gratings and roughness (r=0.814, p<0.05) (see Figure 4.8). The findings imply that there is a relationship between these particular voice parameters. For instance, then the quality of child's voice was perceived as hoarse in singing, the child's voice was likely to be perceived as hyperfunctioning in singing.

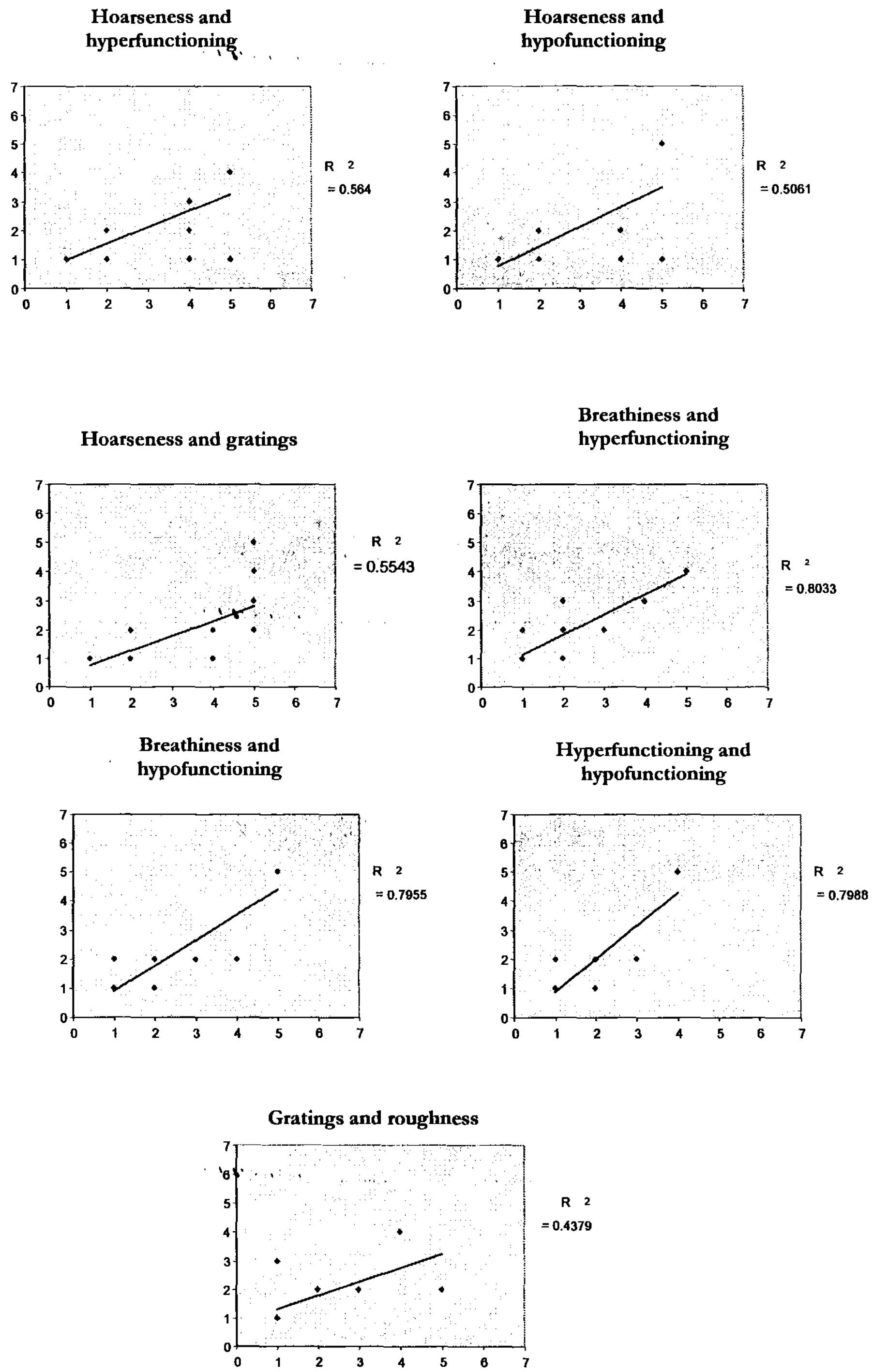


Figure 4.8: Scatterplots for individual voice parameters in singing

4.8 Summary of findings

The children possessed relatively healthy overall voice quality in both speech and singing. For the majority of the children, their voice quality was healthier in singing than in speech. Hoarse, hyperfunctional and breathy voice qualities were perceived as the unhealthiest for a great number of children, biasing their overall voice quality towards unhealthy. Hyponasality, unstable pitch and voice breaks were perceived as the healthiest ones for the majority of children, biasing their overall voice quality towards healthy.

4.9 Perceived speaking and singing competencies

The children's speaking and singing competencies were assessed with the use of a specially designed protocol (see Chapter Five and Appendix 1 for the protocol). The intension was to investigate whether the levels of children's speaking and singing competencies had a significant effect on the overall quality of the children's voices in speech and in singing. The data analyses from the previous studies were replicated (see Section 7.1 for more details on the analyses).

None of the correlations were significant (perceived speaking competency and overall voice quality in speech: $r=-0.197$, n.s.; perceived speaking competency and overall voice quality in singing: $r=-0.143$, n.s.; perceived singing competency and overall voice quality in speech: $r=0.315$, n.s.; perceived singing competency and overall voice quality in singing: $r=0.86$, n.s.) (see Tables 4.9-4.12). The findings indicate that the perceived level of a child's speaking and singing competency does not necessarily significantly influence the overall quality of the child's voice neither in speech nor in singing.

			voice quality in speech in reading	level of speaking competency
Spearman's rho	voice quality in speech	Correlation Coefficient	1.000	-.197
		Sig. (2-tailed)	.	.379
		N	22	22
	level of speaking competency	Correlation Coefficient	-.197	1.000
		Sig. (2-tailed)	.379	.
		N	22	22

Table 4.9: Perceived speaking competency and overall voice quality in speech

			level of speaking competency	singing a song
Spearman's rho	level of speaking competency	Correlation Coefficient	1.000	-.143
		Sig. (2-tailed)	.	.527
		N	22	22
	singing	Correlation Coefficient	-.143	1.000
		Sig. (2-tailed)	.527	.
		N	22	22

Table 4.10: Correlation for perceived speaking competency and overall voice quality in singing

			level of singing competency	voice quality in speech in reading
Spearman's rho	level of singing competency	Correlation Coefficient	1.000	.315
		Sig. (2-tailed)	.	.154
		N	22	22
	voice quality in speech	Correlation Coefficient	.315	1.000
		Sig. (2-tailed)	.154	.
		N	22	22

Table 4.11: Perceived singing competency and overall voice quality in speech

			singing a song	level of singing competency
Spearman's rho	singing	Correlation Coefficient	1.000	.086
		Sig. (2-tailed)	.	.705
		N	22	22
	level of singing competency	Correlation Coefficient	.086	1.000
		Sig. (2-tailed)	.705	.
		N	22	22

Table 4.12: Perceived singing competency and overall voice quality in singing

4.10 Summary

The above findings indicate that perceived level of a child's speaking and singing competency does not necessarily have a significant effect on the overall quality of the child's voice in speech nor in singing. Such a finding indicates that singing training in the sense of increasing child's competency in singing may not necessarily have an impact on the overall quality of one's voice. Moreover, refined skill in a particular vocal behaviour does not necessarily result in enhanced vocal functioning and voice quality in that specific vocal behaviour or in any other vocal behaviour.

4.11 Psychological factors

The data for psychological background factors were analysed as in the first two studies (see Section 5.13 for more details for the analyses). Similarly to the previous studies, the data were classified as belonging to five different categories: learning and behavioural difficulties; self-esteem and self-worth; personality; vocal identity; and attitude to singing.

4.12 Learning and behavioural difficulties

Three different types of learning and behavioural difficulties were looked at in the analyses. These difficulties were: speaking difficulties, reading difficulties and behavioural difficulties. Data for each were analysed separately.

4.12.1 Speaking difficulty

There correlation between overall voice quality in speech and speaking difficulty was statistically significant ($r=0.14$, $p<0.05$) (see Tables 4.13 and 4.14). The correlation was not significant between overall voice quality in singing and speaking difficulty ($r=0.085$, $p> 0.05$, n.s.) (see Table 4.14). This indicates that the quality of a child's voice in speaking may have an impact on the child's ability to speak (and vice versa). However, the overall quality of a child's voice in singing does not have a significant impact on his/ her speaking ability.

The boxplots below (see Figure 4.9) illustrate that children exhibiting speaking difficulties possessed unhealthier overall voice quality in speech than children without speaking difficulties did. There was no significant difference between the former and the latter groups in regard to their overall voice quality in singing. A further alternative explanation is that there is a third factor (such as one's local culture) that is causing the speech and voice distortions to manifest.

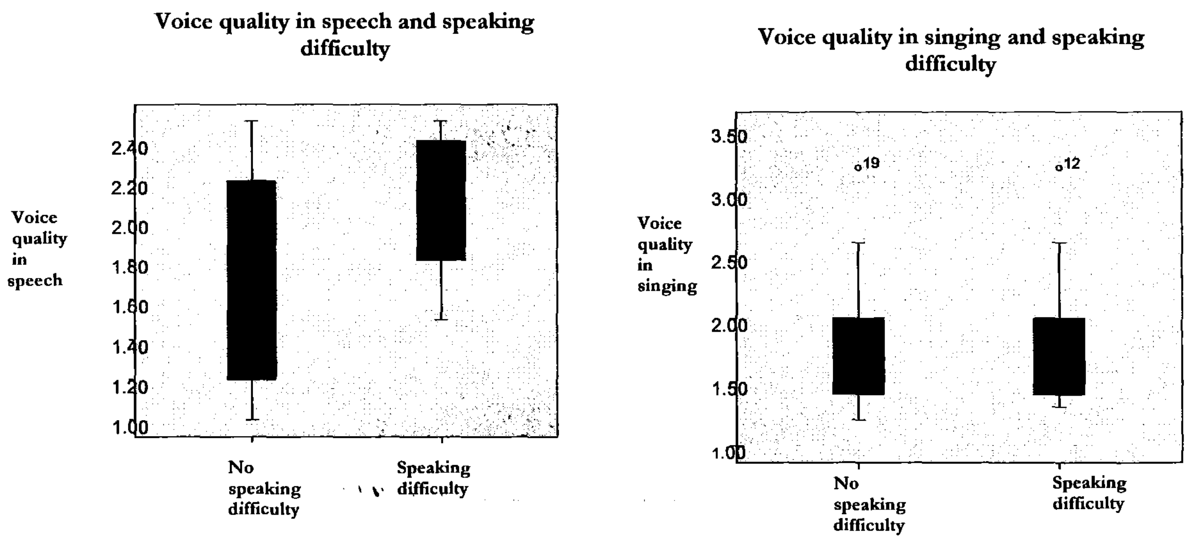


Figure 4.9: Boxplots for the relationship between voice quality in speech and speaking difficulties (left figure), and voice quality in singing and speaking difficulties (right figure)

			voice quality in speech in reading	speaking difficulty
Spearman's rho	voice quality in speech	Correlation Coefficient	1.000	.250
		Sig. (2-tailed)	.	.14
		N	22	22
	speaking difficulty	Correlation Coefficient	.250	1.000
		Sig. (2-tailed)	.14	.
		N	22	22

Table 4.13: Correlation between overall voice quality in speech and speaking difficulty

			speaking difficulty	singing a song
Spearman's rho	speaking difficulty	Correlation Coefficient	1.000	.085
		Sig. (2-tailed)	.	.708
		N	22	22
	singing	Correlation Coefficient	.085	1.000
		Sig. (2-tailed)	.708	.
		N	22	22

Table 4.14: Correlation between overall voice quality in singing and speaking difficulty

4.12.2 Reading difficulty

The main finding was that there was no statistically significant correlation between overall voice quality in speech and reading difficulties (r=-0.74; n.s.) (see Table 4.15). There was no significant correlation between overall voice quality in singing and reading difficulties either (r=-0.126; n.s) (see Table 4.16).

The boxplots below (see Figure 4.10) verify the findings. There were no significant differences as to overall voice quality ratings in speech between children possessing reading difficulties and those not possessing any reading difficulties. The mode of ratings for the former and latter group, as well as the range of ratings, indicated that children possessing reading difficulties exhibited healthier overall voice quality than children not possessing such difficulties did. A further alternative explanation is that a third factor (such as educational opportunities) may have caused both the voice distortions and the reading difficulties to manifest.

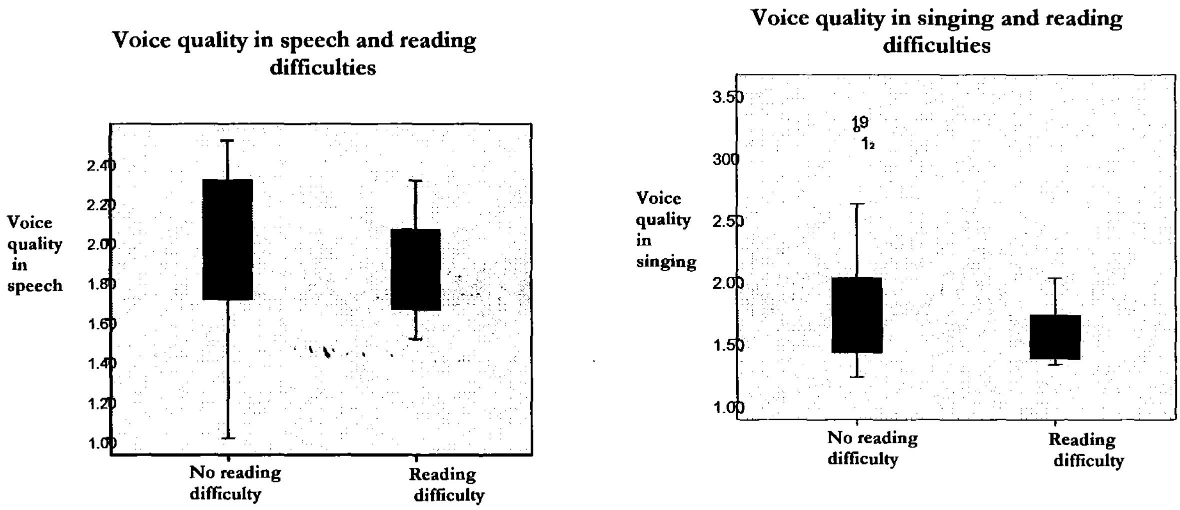


Figure 4.10: Boxplots for the relationship between voice quality in speech and reading difficulties (left figure), voice quality in singing and reading difficulties (right figure)

			voice quality in speech in reading	reading difficulty
Spearman's rho	voice quality in speech	Correlation Coefficient	1.000	-.074
		Sig. (2-tailed)	.	.745
		N	22	22
	reading difficulty	Correlation Coefficient	-.074	1.000
		Sig. (2-tailed)	.745	.
		N	22	22

Table 4.15: Correlation between overall voice quality in speech and reading difficulty

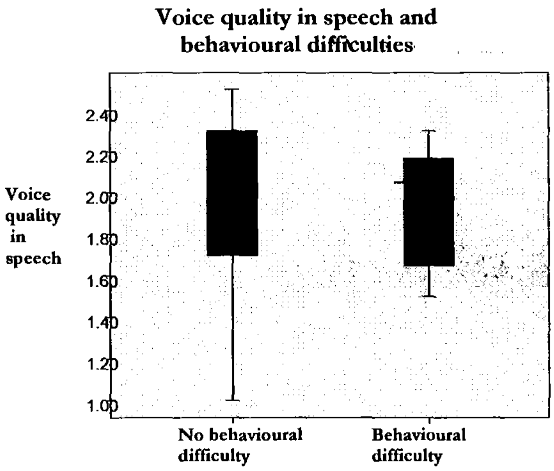
			reading difficulty	singing a song
Spearman's rho	reading difficulty	Correlation Coefficient	1.000	-.126
		Sig. (2-tailed)	.	.576
		N	22	22
	singing	Correlation Coefficient	-.126	1.000
		Sig. (2-tailed)	.576	.
		N	22	22

Table 4.16: Correlation between overall voice quality in singing and reading difficulty

4.12.3 Behavioural difficulties

The correlation between overall voice quality in speech and behavioural difficulties was statistically (r=0.047; p<0.05) (see Table 4.17). The correlation between overall voice quality in singing and behavioural difficulties was not significant (r=-0.379; n.s) (see Table 4.18).

The boxplots below (see Figure 4.11) verify the findings. The overall voice quality in speech differed between the two groups of children (i.e. those possessing behavioural difficulties and those not possessing such difficulties), with the differences being relatively minimal (mode: 1.7 versus mode: 2.1). The finding was similar in regard to voice quality in singing, with minimal differences being recorded between the two groups of children (mode: 1.5 versus mode: 1.7). For both groups, the range of the voice quality ratings was wider in speech than in singing. As with speech disorder and reading difficulties, further alternative explanation is that a third factor (such as school environment) may have caused both the voice distortions and the behavioural difficulties to manifest.



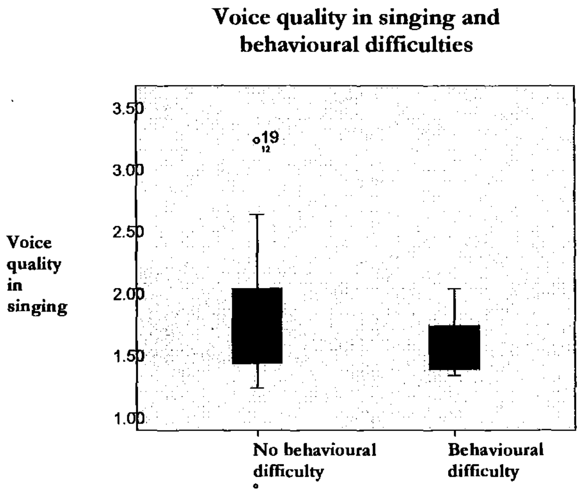


Figure 4.11: Boxplots for the relationship between voice quality in speech and behavioural difficulties (left figure), voice quality n singing (right figure) and behavioural difficulties

			behavioural problem	voice qualtiy in speech in reading
Spearman's rho	behavioural problem	Correlation Coefficient	1.000	.047
		Sig. (2-tailed)	.	.837
		N	22	22
	voice quality in speech	Correlation Coefficient	.047	1.000
		Sig. (2-tailed)	.837	.
		N	22	22

Table 4.17: Correlation between overall voice quality in speech and behavioural difficulty

			singing a song	behavioural problem
Spearman's rho	singing a song	Correlation Coefficient	1.000	.379
		Sig. (2-tailed)	.	.082
		N	22	22
	behavioural problem	Correlation Coefficient	.379	1.000
		Sig. (2-tailed)	.082	.
		N	22	22

Table 4.18: Correlation between overall voice quality in singing and behavioural difficulty

4.13 Vocal identity

Vocal identity factor was address as in the first two studies (see Section 6.15 for more details on the analyses). The data were analysed qualitatively, with the help of EXCEL-software programme. The children were looked at as one group in the analyses. Since none of the children possessed distinctively unhealthy overall voice quality (i.e. ratings between 5-7), children classified as possessing less healthy overall voice quality (i.e. mean ratings between 3-4) were compared to those classified as possessing healthy overall voice quality (i.e. mean ratings between 1-2).

The first finding was that 59% of the children perceived speaking and singing behaviour as separate entities, whilst 41% of them perceived the vocal behaviours as interconnected. The former group stated that their voices were different in speaking in comparison to singing, whilst the latter group stated that their voices were the same in both speaking and in singing behaviours (see Table 4.19 below).

As an example, one boy from the latter groups stated:

'The voice is pretty much the same in speech and in singing...Hhmm...Yes, it's the same.'

On the contrary, a girl from the former group claimed:

'Definitely different. My voice sounds so different in speaking and so different in singing that it can't be the same.'

A significant number of the children (N=13) stated that they liked how their voice sounded both in speaking and singing behaviours. Prevalence of the responses can be seen in the table below (see Table 4.19). The majority of the children (N= 4) with unhealthier overall voice quality liked how their voice sounded in both vocal behaviours. For instance, one boy with unhealthier overall voice quality argued:

'Yes (I like my voice in speech.). It sounds nice. Yes (I like my voice in singing). It sounds beautiful and flowing.'

Another girl claimed with unhealthier overall voice quality claimed:

'I like my voice in speech. It sounds normal. I also like it in singing. It sounds even better.'

For the children possessing healthier overall voice quality, the percentage for disliking how their voice sounded in singing was higher than the percentage for disliking the sound of their voice in speech. For example, one boy stated:

'I don't like my voice when I sing. It doesn't sound as good as in speech. I have to try harder to sing so it makes my voice worse.'

Another girl with healthy overall voice quality argued:

'My voice sounds a bit nasal but good when I speak. When I sing, I don't like it...It doesn't sound so good and it sounds too nasal.'

Out of the whole class, 22.2% could not identify with their voices. For instance, one boy claimed:

'I don't know...I don't think about my voice. I can't really say whether I like it or not.

Group	Speech		Singing	
	Likes own voice	**Does not like own voice**	**Likes own voice**	**Does not like own voice**
The whole class (N= 17)	64.7% (N= 11/ 17)	17.6% (N= 3/ 17)	88.2% (N= 15/ 17)	5.9% (N= 1/ 17)
Children with unhealthier overall voice quality (N=6)	66.7% (N= 4/ 6)	33.3% (N= 2/ 6)	50.0% (N= 3/ 6)	16. 7% (N = 1/ 6)
Children with healthier overall voice quality (N=11)	72.7% (N= 8/ 11)	9.1% (N= 1/ 11)	63.6% (N= 7/ 11)	16.7% (N= 1/ 6)

Table 4.19: Percentages of responses received for vocal identity statements (note: 22.2% in the whole class could not identify with their voice)

The third finding was that the majority of the children (88%) described their voices in positive terms, whilst 22% described their voices in negative terms. For example for a positive description, a boy stated:

'Yes, my voice sounds really good when I speak. It sounds loud and powerful and good. When I sing, it is also clear and powerful.'

As an example for a negative description, one girl described her voice as:

'My voice sounds kind of harsh when I speak. It also sounds kind of rough when I sing.'

The children who described their voices in negative terms were doing so only when referring to how their voices sounded in singing. As an example, one girl described her voice the following way.

'When I speak, my voice sounds a bit sticky but clear and a bit nasal. I like it that way. Singing...It sounds deep. A bit out of tune sometimes. I like it.'

4.14 Self-esteem and self-worth

The level of the children's self-esteem and self-worth were analysed similarly to the first two studies (see Section 8.17 for more details on the analyses).

The first finding was that a significant number of the children (n=18) regarded themselves confident and happy (see Table 4.20 below). None of the participant children regarded themselves angry. From the received responses, two distinct groups of self-perceptions emerged. The first group focussed on positive biographic perceptions. Children in this group (n=13) described themselves as confident, happy and outgoing. The second group focussed on introverted biographic perceptions. Children in this latter group (n=9) described themselves as quiet and worried.

The second finding was that most of the children possessing unhealthier overall voice quality (N=7) regarded themselves as outgoing and talkative. 77.5% of these children stated that they were confident and only 11.1% stated that they were worried. There was a wider diversity of responses amongst the children possessing healthier overall voice quality (N=12) (see Table 4.5).

Characteristics	Percentage of children (N= 22)	Healthy voice quality (N=13)	Unhealthy voice quality (N=9)
Confident	81.8% (N = 18/ 22)	84.6% (N= 11/ 13)	77.8% (N= 7/ 9)
Happy	81.8% (N= 18/ 22)	76.9% (N= 10/ 13)	55.6% (N= 5/ 9)
Cheerful	45.4% (N= 10/ 22)	69.2% (N= 9/ 12)	44.4% (N= 4/ 9)
Quiet	31.8% (N= 7/ 22)	61.5% (N= 8/ 13)	22.2% (N= 2/ 9)
Outgoing	31.8% (N= 7/ 22)	38.5% (N= 5/ 13)	100% (N= 9/ 9)
Talkative	22.7% (N= 5/ 22)	38.5% (%/ 13)	77.8% (N= 7/ 9)
Worried	13.6% (N= 3/ 22)	84.6% (N= 11/ 13)	11.1% N= 1/ 9)
Angry	0% (N 0/ 22)	7.7% (N= 1/ 13)	11.1% (N= 1/ 9)

Table 4.20: Percentages of responses received for personality characteristics

The third finding was that children with unhealthier overall voice quality held more negative self-efficacy perception as to their future than children with healthiererall voice quality did (see Table 4.21). Children with healthier voice quality were more confident about their future than children with unhealthier voice quality were. The findings indicate that differences were recorded between children possessing healthier voice quality and those possessing unhealthier voice quality in regard to biographic perceptions. Although it may be that children's vocal functioning and voice quality are directly linked to their biographic feelings, there may have been a third factor in play, which equally influenced the above factors.

Items measuring self-worth / self-esteem	**Unhealthy voice quality (scores 5-7) (N= 9)**	**Healthy voice quality (scores 1-3) (N= 13)**
(S)he believes that (s)he would do well in a future event.	77% (N= 7/ 9)	84.6% (N= 11/ 13)
(S)he believes that (s)he would be able to engage in any type activity.	55% (N= 5/ 9)	84.6% (N= 11/ 13)

Table 4.21: Percentages of statements for self-efficacy statement

4.15 Personality factors

Data for the children's personality characteristics were analysed as in the first two studies. The results from the personality inventory were analysed according to the guidelines set in the manual for the test (see Section 8.18 for full description on the analyses for the test).
More than half of the children (n=13) regarded themselves as hyperactive and extraverted, whilst less than half (n=8) regarded themselves as shy and introverted (see Table 4.22 below). A significant number (n=12) regarded themselves as obedient and well-behaved.

Children possessing unhealthier overall voice quality were exhibited two distinct groups in regard to their self-stated personality characteristics. More than half (n=5) regarded themselves as hyperactive and extraverted, whilst the rest (n=4) regarded themselves as shy and introverted. All of the children regarded themselves obedient and well-behaved. The majority (n=10) of the children possessing healthier overall voice quality regarded themselves as extraverted and hyperactive. The rest (n=5) regarded themselves as shy and introverted. The majority (n=12) of the children regarded themselves as obedient and well-behaved.

Personality characteristic	**Percentage of children (N=22)**	**Healthy voice quality (N=13)**	**Unhealthy voice quality (N=9)**
Hyperactive and Extraverted	50.0% (N= 11/ 22)	69.2% (N= 9/ 13)	55.6% (N= 5/ 9)
Shy and Introverted	36.4% (N= 8/ 22)	23.1% (N= 3/ 13)	44.4% (N= 4/ 9)
Obedient and Well-behaved	50.0% (N= 11)	92.3% (N= 12/ 13)	100% (N= 9/ 9)

Table 4.22: Prevalence of personality characteristics

4.16 Attitude to singing

The data for the children's attitude to singing were analysed as in the first two studies (see Section 6.19 for more details on the analyses). The first finding was that the children who were engaged in singing activities on a regular basis were more likely to engage in additional musical and performing arts hobbies than were the children who were not engaged in singing on a regular basis (see Table 4.23 below).

The second finding was that there were no major differences between children possessing healthier overall voice quality and those possessing unhealthier overall voice quality as to their engagement in musical and performing arts hobbies. The findings imply that the above factors are not necessarily connected to one another.

Additional hobby	Engaged in singing on a regular basis (N= 12)	Not engaged in singing on a regular basis (N= 7)	Healthy voice (N=12)	Unhealthy voice (N=6)
Playing of musical instrument(s)	83.3% (N= 10/ 12)	14.3% (N= 1/ 7)	38.5% (N= 5/ 13)	40.0% (N= 3/ 6)
Other musical or performing arts hobby (such as drama)	8.5% (N= 11/ 12)	14.3% (N= 1/ 7)	7.7% (N= 1/ 13)	16.6% (N= 1/ 6)

Table 4.23: Percentages of responses for engaging in additional musical and performing arts hobbies

The second finding was that there were no general trends as to the children's reasons for being, or not, being engaged in singing. The responses included reasons such as: time goes past faster when you sing; singing sounds nice; it is fun to learn new songs; and it is a nice activity to be engaged in either on your own or with other children. For example, one girl stated:

'You can do it alone but you can also do it with other people so it's fun.'

Another boy stated:

'I like learning new songs.'

The reasons for not being willing to be engaged in singing also varied. The responses included statements such as: singing is boring; singing makes you tired; singing makes your voice hoarse; and singing makes your throat tired. For example, one boy stated:

'I don't have a good singing voice…Anyway, singing makes your voice hoarse.'

Children who possessed unhealthier overall voice quality were divided into two distinct groups when enquired about their enjoyment of singing. 66% (n=4) stated that they did not enjoy singing and 44% (n=6) stated that they enjoyed singing. For example for a negative statement, one boy argued:

'I don't like singing because then I hear my own voice very well and I don't like that.'

As an example for a positive statement, a girl claimed:

'Yeah, I like singing a lot. I would like to do it more than I can. I do it at home sometimes on my own.'

A greater number (92%) (N=11) of children who possessed healthier overall voice quality stated that they enjoyed singing. Only one participant out of these children stated that he did not enjoy singing. This particular child stated:

'I don't really enjoy singing. I prefer other musical things. Rap-singing is ok though. My teacher says it's not proper singing. Is it?'

4.17 Psychological function and impact of singing

The data gathered for the psychological function and impact of singing on the children were analysed as in the first two studies (see Section 8.20 for more details on the analyses). Comparisons were made between children who stated to enjoy singing and those who stated not to enjoy singing.

The first finding was that singing served a number of psychological functions for the participant children. These functions were: singing makes one feel like one was good at a specific activity; singing makes one feel cheerful; singing is relaxing; and one gains a sense of achievement through learning new songs. As an example, one girl stated:

'I like learning new songs. It makes me feel like I am learning something good when I learn new songs.'

Another example is a boy who argued:

'I just feel like...happy (after a singing session). I feel much better (than before a singing session).'

The second finding was that the children who stated as not being engaged in singing on a regular basis provided a number of reasons as to their dislike for such an activity. The reasons included statements such as: singing makes one feel anxious; one does not like how one's voice sounds like in singing and so singing makes one feel bad; and one does not see the point of being engaged in singing. As an example, one girl stated:

'I don't like the way my voice sounds when I sing. Then when I hear my voice, I start feeling bad about myself too.'

Another boy claimed:

'I just don't see the point. I'd much rather be doing something else I enjoy more.'

4.18 Summary

On the basis of the above findings, it is evident that a number of psychological factors are connected to children's overall voice quality and vocal functioning. Voice quality is connected to a network of psychological factors that consists of: learning difficulties; reading difficulties; speech disorders; behavioural difficulties; vocal identity; levels of self-esteem and self-worth; and personality characteristics. Singing seems to have an impact on this particular network.

More extreme voice distortions influenced the network in a negative way. Milder forms of voice distortion did not necessarily have a significantly deteriorating effect on the network. Particular psychological factors (such as speaking difficulties) may be more easily influenced by the quality of a child's voice than other psychological factors (such as reading difficulties). Thus, on the basis of such findings, the hypotheses from the first two studies that advocated the idea that a network of psychological factors that simultaneously influence children's overall vocal functioning and voice quality in both speaking and singing behaviours were supported by the findings from the current study.

4.19 Sociological factors

Data gathered for sociological factors were analysed as in the previous studies (see Section 9.21 for more details on the analyses). The findings were divided into three categories: sex; siblings; and leisure activities. Linguistic background was omitted from the analyses since all the children spoke Finnish as their first language. Socioeconomic background was omitted from the analyses since such information was regarded as too confidential by the head teacher of the school. Age was omitted from the analyses since the exact birth dates of the children's were not known due to the fact that the school did not have the authority to pass such information on to a third party.

4.20 Siblings

Since none of the children had more than two siblings, statistical analyses between children possessing more than two siblings and those possessing less than two siblings were not feasible. There were only two children who were the middle ones in their families and one child who was the only child in her family. Therefore, comparisons were made between those who were the eldest in their families and those who were the youngest in their families.

In terms of overall voice quality in speech, there were no major differences between the two groups (see Table 4.24 below). In terms of overall voice quality in singing, the children who were the eldest in the family possessed unhealthier overall voice quality than the children who were the youngest in their family (2.1 versus 1.8). However, the difference between the voice quality ratings was relatively small. Therefore, no firm conclusions can be drawn from the findings.

Sibling order	**Mean rating for voice quality in speech**	**Mean rating for voice quality in singing**
Eldest (N=10)	2.3	2.1
Youngest or no siblings (N=9)	2.4	1.8

Table 4.24: Sibling-order and prevalence of unhealthy voice characteristics

4.21 Sex

The figures below illustrate the distribution of overall voice quality ratings in speech and those in singing for boys and girls, separately (see Figure 4.25). The voice ratings appear to be slightly unhealthier for boys than for girls. Six boys obtained ratings above 2.0, whilst only three girls obtained ratings above 2.0. There were no specific general trends recorded as to which vocal behaviour was perceived as healthier with reference to either sex.

Non-parametric statistical analyses between the two sexes were not significant (for speech: z=1.67, n.s.; for singing: z=0.640, n.s.). Such findings suggest that there are relatively small differences between the two sexes and such differences do not reach statistical significance.

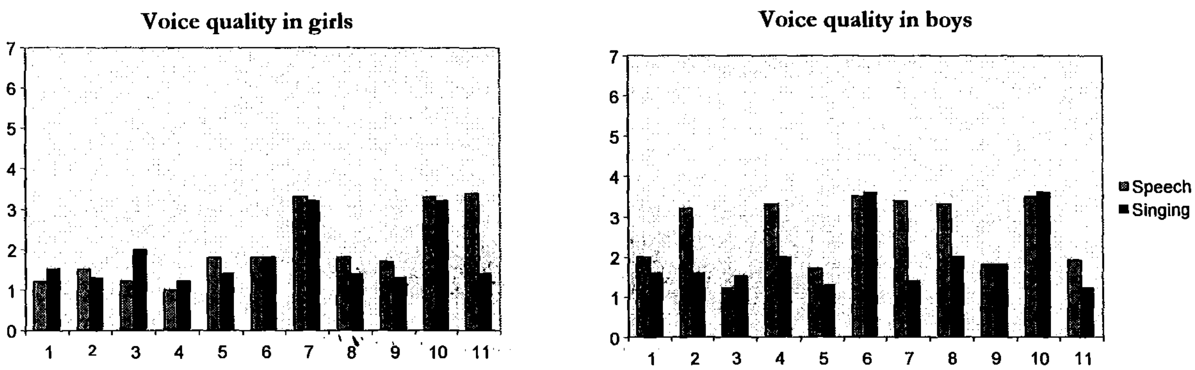


Figure 4.25: Relationship between gender and overall voice quality in speech and singing (girl, left figure; boys, right figure)

4.22 Leisure activities

Similarly to the findings from the previous studies, children who possessed unhealthier overall voice quality stated that they preferred active hobbies to solitary hobbies in their leisure time. Children who possessed healthier overall voice quality preferred more solitary leisure activities (see Table 4.26). The findings imply that the activities that the children undertook in their leisure time were linked to their vocal functioning and voice quality. Alternatively, it may be that a third factor (such as personality characteristics) was influencing the above factors simultaneously.

Group	Active hobbies	Passive hobbies	Mixed hobbies
Children with unhealthier overall voice quality (N=6)	83.3% (N= 5/ 6)	0% (N= 0/ 6)	16.7% (N= 1/ 6)
Children with healthier overall voice quality (N=12)	8.3% (N= 1/ 12)	75% (N= 9/ 12)	16.7% (N= 2/ 12)

Table 4.26: Leisure activities and prevalence of unhealthy voice quality characteristics

4.23 Summary

The findings for sociological factors can be summarised as:

a) Older siblings possessed slightly unhealthier overall voice quality in singing than younger siblings did. However, the difference was not statistically significant.

b) Boys possessed slightly unhealthier overall voice quality in speech than girls did. However, the difference was not statistically significant.

c) Children who possessed unhealthier overall voice quality preferred being engaged in active hobbies in their leisure time, whereas children who possessed healthier overall voice quality preferred being engaged in more passive hobbies.

Appendix 5: Fourth Study

5.1 Introduction and information on participants

The focus of this chapter is on data from the fourth study (Finland, 2006, study 2). The analyses from the previous studies were replicated (see Section 6.1 for more details on the analyses). The participants for this study (Finland, 2006, study 2) were 18 children from a school located in greater Helsinki (see Section 5.9.2 for more information on the participants). As with the previous studies, all 18 children were assessed on the specially designed singing and speaking protocol (see Chapter Five for details on the protocol). The assessment outcome was analysed as in the first study (see Section 6.3 for more details). Similarly to the second and the third studies, the children were treated as one group and they were not divided into sub-groups due to the fact that all of the participants had undergone the same type and amount of formal singing training.

5.2 Overall voice quality in speech and overall voice quality in singing

The descriptive statistics demonstrated that the overall voice quality ratings in speech were similar to those in singing for the whole group (see Table 5.1 and Figure 5.1). The mean rating for speech was 1.84 compared with 1.87 for singing. The standard deviation was slightly greater for singing than for speech (0.276 versus 0.266). The range of the ratings varied by 1.80 points for both speech (1.0-1.8) and singing (1.0-1.8).

Participants	**Speech**			**Singing**		
	Mean	**Standard Deviation**	**Range**	**Mean**	**Standard Deviation**	**Range**
Whole class (n=18)	1.31	0.276	0.80	1.30	0.266	0.80

Table 5.1: Descriptive statistics for voice quality ratings in speech and in singing where 1=healthy, 2=healthy, 3=healthy, 4=less healthy, 5=less healthy, 6=unhealthy, 7=extremely unhealthy (colours indicate three broad categories of vocal health, evidence of some vocal problem, or more extreme unhealthy voice use)

The bar chart below (see Figure 5.1) illustrates that, for the majority of the children, there were relatively small differences between overall voice quality in speech and that in singing. For six of the children, their voice quality was healthier in singing than in speech. For another six other children, the finding was the opposite (i.e. their overall voice quality was unhealthier in speech than in singing).

Overall voice quality in speech and overall voice quality in singing for the whole class

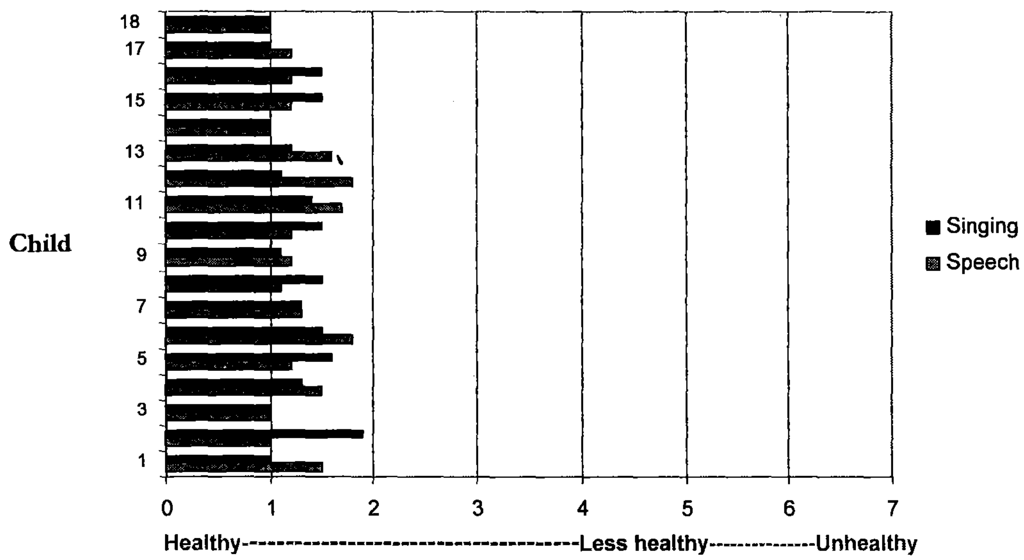
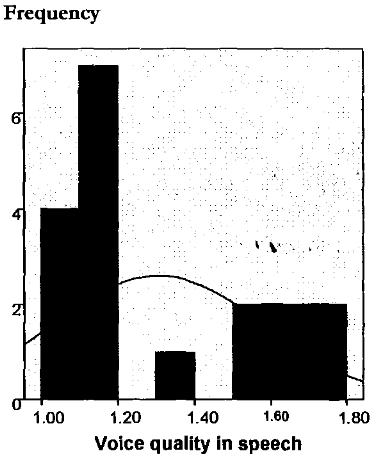


Figure 5.1: Bar chart for overall voice quality ratings in speech and in singing for the whole class by individual participant

When the overall voice quality ratings were rank-ordered for speech and for singing, the distribution for the ratings in both vocal behaviours were skewed towards healthy overall voice quality (see Figure 5.2 below). For both speech (skewness distribution: 0.676) and singing (skewness distribution: 0.466), the distributions were positively skewed, with the ratings clustering between 1.00 and 1.80.



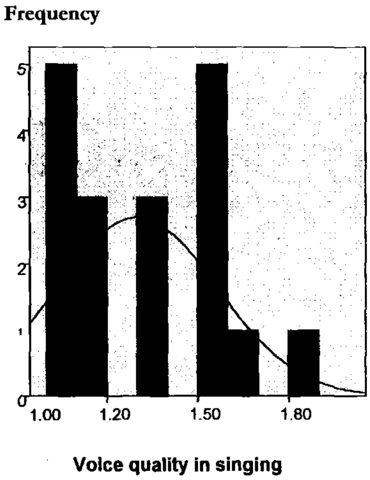


Figure 5.2: Distribution of rank-ordered voice quality ratings in speech (left figure) and in singing (right figure) for the whole class

The scatterplot below (see Figure 5.3) illustrates the relationship between overall voice quality ratings in speech and those in singing for the whole class. The plot indicates a neutral relationship. The non-parametric test further illustrates that there was a significant correlation between the overall voice quality ratings in speech and those in singing ($r=0.519$; $p<0.05$) (see Table 5.2).

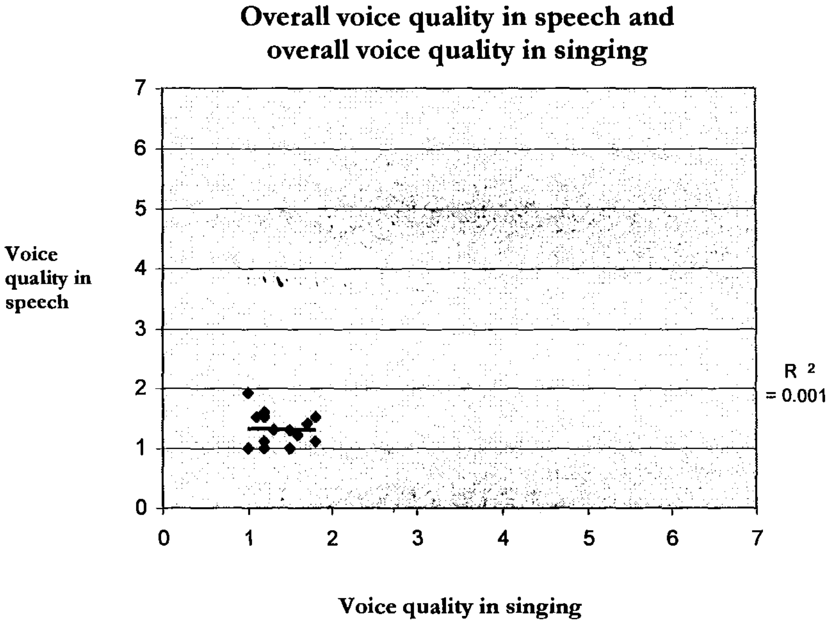
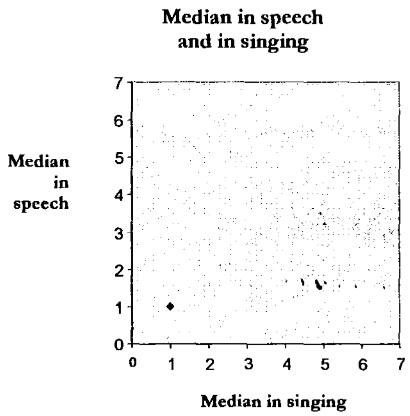


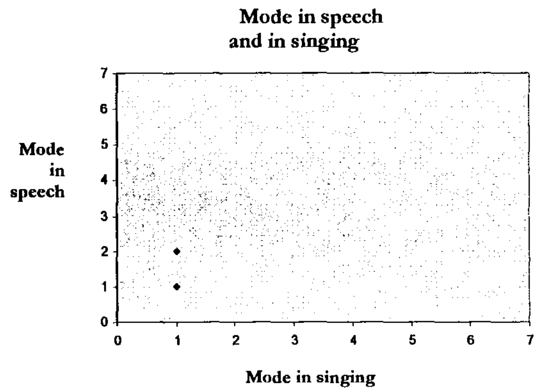
Figure 5.3: Correlation between overall voice quality ratings in speech and those in singing for the whole class

			voice quality in speech in reading	singing a song
Spearman's rho	voice quality in speech	Correlation Coefficient	1.000	.655(*)
		Sig. (2-tailed)	.	.013
		N	18	18
	singing	Correlation Coefficient	.655(*)	1.000
		Sig. (2-tailed)	.013	.
		N	18	18

Table 5.2: Correlation between overall voice quality in speech and overall voice quality in singing

The mode, median and standard deviations were calculated for each voice parameter in speech and in singing in order to investigate whether the mean scores for the voice quality ratings were an appropriate measure for representing the children's overall voice quality (see Tables 77-80 in Appendix 1). For the mode and the median, the values clustered at 1.00, indicating a positive correlation between the ratings. For the median, the correlation was significant (r=0.721, p< 0.05). For the mode, the correlation was also significant (r=0.537, p<0.05). For the standard deviation, the correlation was not statistically significant (r=0.331; n.s.). (See Figure 5.4 below and Tables 5.3-5.6). Despite the insignificant difference between the standard deviations, the findings illustrate that the different central tendency measures provided the same outcomes, indicating that the use of the mean ratings in subsequent analyses was appropriate.





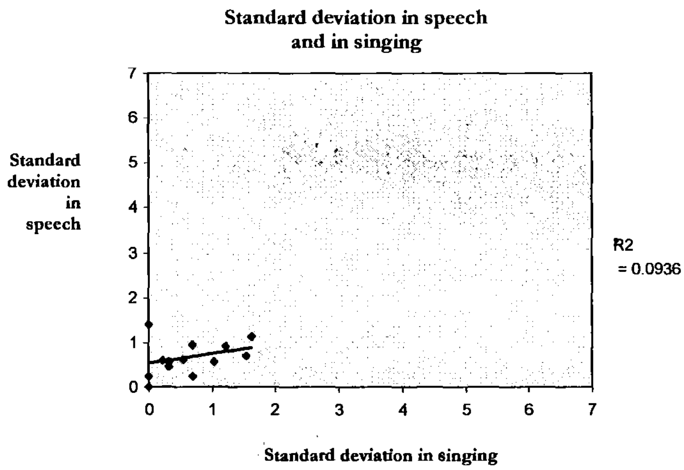


Figure 5.4: Scatterplots for: median for overall voice quality in speech and that in singing for the whole class (left top figure); mode for overall voice quality in speech and that in singing for the whole class (right top figure); and standard deviation in speech and in singing (lower figure)

	Speech= mode	Singing= mode	Speech=Std. Deviation	Singing=Std. Deviation	Speech= median	Singing=median
hoarseness	1.00	1.00	0.32	0.57	1.00	1.00
breathiness	1.00	1.00	1.27	0.92	1.00	1.00
hyperfunctional	1.00	1.00	0.707	0.23	1.00	1.00
hypofunctional	1.00	1.00	1.04	0.58	1.00	1.00
gratings	1.00	1.00	1.64	1.14	1.00	1.00
rough	1.00	1.00	0.32	0.47	1.00	1.00
breaks	1.00	1.00	0.32	1.03	1.00	1.00
unstable	1.00	1.00	0.00	1.41	1.00	2.00
hard	1.00	1.00	0.707	0.94	1.00	1.00
vocal fry	1.00	1.00	1.55	0.71	1.00	1.00
audible	1.00	1.00	0.00	0.24	1.00	1.00
hypernasal	1.00	1.00	0.24	0.55	1.00	1.00
hyponasal	1.00	1.00	0.00	0.00	1.00	1.00

Table 5.3: Descriptive statistics for separate voice parameters in speech and in singing

			Voice quality in speech	Voice quality in singing
Spearman's rho	St.dev. speech	Correlation Coefficient	1.000	-.209
		Sig. (2-tailed)	.	.493
		N	13	13
	St.dev.singing	Correlation Coefficient	-.209	1.000
		Sig. (2-tailed)	.493	.
		N	13	13

Table 5.4: Correlation between standard deviation for overall voice quality in speech and the mode for overall voice quality in singing

			Voice quality in speech	Voice quality in singing
Spearman's rho	Median speech	Correlation Coefficient	1.000	.721(**)
		Sig. (2-tailed)	.	.005
		N	13	13
	Median singing	Correlation Coefficient	.721(**)	1.000
		Sig. (2-tailed)	.005	.
		N	13	13

Table 5.5: Correlation between median for overall voice quality in speech and the median for overall voice quality in singing

			Voice quality in speech	Voice quality in singing
Spearman's rho	Mode speech	Correlation Coefficient	1.000	.537
		Sig. (2-tailed)	.	.058
		N	13	13
	Mode singing	Correlation Coefficient	.537	1.000
		Sig. (2-tailed)	.058	.
		N	13	13

Table 5.6: Correlation between mode for overall voice quality in speech and the mode for overall voice quality in singing

In addition to comparing the means between the overall voice quality ratings, individual voice parameters in speech were compared to those in singing for each child. The hypothesis was that the ratings did not differ significantly between the two vocal behaviours. The hypothesis was supported by the findings from the study. For all the children (n= 18), the results were not significant (see Table 5.7), suggesting that voice quality in speech did not differ significantly from that in singing

	voicebeh	N	Mean Rank	Sum of Ranks	Mann Whitney U/ exact.sig.
sb1	speech	13	14.08	183.00	77.0/.724
	singing	13	12.92	168.00	
	Total	26			
sb2	speech	13	11.50	149.50	58.5/.186
	singing	13	15.50	201.50	
	Total	26			
sb3	speech	13	14.00	182.00	78.0/.762
	singing	13	13.00	169.00	
	Total	26			
sb4	speech	13	14.04	182.50	77.50/.724
	singing	13	12.96	168.50	
	Total	26			
sb5	speech	13	12.12	157.50	66.50/.362
	singing	13	14.88	193.50	
	Total	26			
sb6	speech	13	12.62	164.00	73.00/.579
	singing	13	14.38	187.00	
	Total	26			
sb7	speech	13	11.92	155.00	64.00/.311
	singing	13	15.08	196.00	
	Total	26			
sb8	speech	13	12.88	167.50	76.50/.687
	singing	13	14.12	183.50	
	Total	26			
sb9	speech	13	14.50	188.50	71.50/.511
	singing	13	12.50	162.50	
	Total	26			
sb10	speech	13	12.00	156.00	65.00/.336
	singing	13	15.00	195.00	
	Total	26			
sb11	speech	13	13.92	181.00	79.00/.801
	singing	13	13.08	170.00	
	Total	26			
sb12	speech	13	14.12	183.50	76.50/.687
	singing	13	12.88	167.50	
	Total	26			
sb13	speech	13	14.08	183.00	77.00/.724
	singing	13	12.92	168.00	
	Total	26			
sb14	speech	13	13.50	175.50	84.50/1.00
	singing	13	13.50	175.50	
	Total	26			
sb15	speech	13	12.85	167.00	76.00/.687
	singing	13	14.15	184.00	
	Total	26			
sb16	speech	13	12.00	156.00	65.00/.336
	singing	13	15.00	195.00	
	Total	26			
sb17	speech	13	13.50	175.50	84.50/1.00

	singing	13	13.50	175.50	
	Total	26			
sb18	speech	13	13.92	181.00	79.00/.801
	singing	13	13.08	170.00	
	Total	26			

Table 5.7: Relationship between voice quality in speech and voice quality in singing for each child

5.3 General impressions and detail of voice quality

As in the previous studies, general trends and specific details within the voice quality ratings were explored. The mean rating for each individual voice parameter, general trends within these mean ratings and the distribution of the ratings were examined.

5.4 Voice parameters in speech and in singing

In addition to investigating the relationship between the mean ratings (i.e. overall voice quality) in speech and those in singing, non-parametric tests were carried out with individual voice parameters. The correlation between the 13 individual voice parameters in speech and the same ones in singing was calculated for the whole group in order to investigate whether the same results were found through such calculation as with the mean ratings. The hypothesis was that the ratings did not differ significantly. It was supported by the finding from the analysis since the result was not significant ($z=1.023, 0.576$; n.s.) (see Table 5.8). Such a finding indicates that the quality in one vocal behaviour tends to be similar in the other.

		voice quality in speech	singing
Most Extreme Differences	Absolute	.324	.278
	Positive	.000	.182
	Negative	-.465	-.311
Kolmogorov-Smirnov Z		1.023	.576
Asymp. Sig. (2-tailed)		.133	.245

Table 5.8: Kolmogorov-Smirnov non-parametric test for testing the relationship between voice quality in speech and voice quality in singing when taking all the separate voice parameters into consideration

5.5 Voice parameters and their impact on overall voice quality

As in the previous studies, ratings for the individual voice parameters for individual children were looked at in more detail in order to investigate (i) whether any specific voice parameters seemed to be influencing the overall voice quality of the children's voices and (ii) whether the means were an appropriate tool in comparing the children's voice quality characteristics in speech to those in singing.

In terms of voice quality in speech, hypofunctional (n=3) and hyperfunctional (n=1) were the only qualities perceived as less healthy within this particular group of children and, even so, only for a minority of the children. In terms of voice quality in singing, audible inhalation (n=2) and roughness (n=1) were perceived as the unhealthiest parameters (see Table 5.9 below). Again, the finding was applicable only to a minority of the children. However, it should be noted that there were no statistically significant differences between the distributions of the ratings for each of the 13 parameters, implying that the ratings for the individual voice parameters did not differ statistically significantly from one another (Kruskal-Wallis: z=0.422>0.05, n.s.).

Voice parameter	Speech	Singing
Hypofunctional	16.7% less healthy	100% healthy
Hyperfunctional	5.5% less healthy	100% healthy
Audible inhalation	100% healthy	11.1% less healthy
Rough	100% healthy	5.5% less healthy
Unstable pitch/ quality	100% healthy	38.9% less healthy
Hyponasal	100% healthy	100%healthy

Table 5.9: Percentages for healthy and unhealthy voice quality characteristics in speech and those in singing for the voice parameters rated as the healthiest and the unhealthiest

When the mean ratings of the individual voice parameters in both of the vocal behaviours were rank-ordered, the differences between the ratings in speech and those in singing became more evident (see Table 5.10). The biggest differences were recorded in: audible inhalation (0.9 points higher in singing than in speech); voice breaks (0.9 points higher in speech than in singing); and hypofunction (0.8 points higher in singing than in speech).

It should be noted that six voice parameters (roughness, audible inhalation, hypofunctioning, hyperfunctioning, breathiness, hypernasality) were rated as unhealthier in speech than in singing, and five other parameters (voice-breaks, hoarseness, hard glottal attack, vocal fry, unstable pitch) were rated as unhealthier in singing than in speech (see Table 5.10). Such a finding implies that there were no general trends as to the vocal behaviour that was likely to be healthier in the individual voice parameters. More specifically, the minimal differences between the mean ratings for the individual voice parameters could function either way (i.e. the ratings could be healthier in either behaviour).

Voice parameter	Mean rating in speech	Mean rating in singing
Rough	2.0	1.4
Audible inhalation	2.1	1.2
Hypofunctional	2.0	1.2
Hyperfunctional	1.7	1.4
Breathy	1.4	1.3
Hypernasality	1.2	1.1
Voice breaks	1.2	2.3
Hoarse	1.1	1.3
Gratings	1.1	1.1
Hard glottal attack	1.1	1.7
Vocal fry	1.1	1.3
Unstable pitch/ quality	1.0	1.1
Hyponasality	1.0	1.0

Table 5.10: Rank-ordered mean ratings for individual voice parameters where 1=healthy, 2=healthy, 3=healthy, 4=less healthy, 5=less healthy, 6=unhealthy, 7=extremely unhealthy (colours indicate three broad categories of vocal health, evidence of some vocal problem, or more extreme unhealthy voice use

The radar-charts below (see Figure 5.5) verify the findings from the Tables above.

The radars illustrate the mean ratings for each voice parameter and, subsequently, highlight the healthiest and the unhealthiest parameters. The radars illustrate the minimal differences between the mean ratings for the individual voice parameters in both of the vocal behaviours.

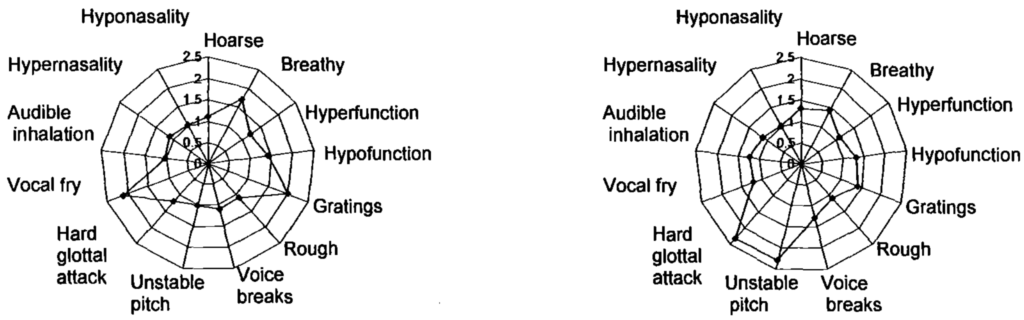


Figure 5.5: Radar-figures of mean ratings for individual voice parameters in speech (left figure) and those in singing (right figure) for the whole class

5.6 Individual differences between participants

General trends were noted in the class of children in terms of the individual voice parameters that were perceived the healthiest and the unhealthiest. Such characteristics were looked at in more detail in both speech and singing.

5.6.1 Unhealthy characteristics

When looking at the distribution of the voice quality ratings for each individual child in their speaking behaviour (see Figure 5.6 and Table 5.11), vocal fry and gratings received the greatest number of responses as to less healthy quality (n=4). Breathiness was perceived as belonging to the category of unhealthy voice quality for one individual. Therefore, the ratings for the above parameters were likely to have biased these particular children's overall voice quality in speech towards unhealthy.

When looking at the distribution of the voice quality ratings in singing (see Figure 5.6 and Table 5.11), unstable pitch gathered the highest number of individual ratings (n=13) that were perceived to belong to the category of less healthy voice quality. Therefore, the ratings for this particular parameter were likely to have biased these particular children's overall voice quality in singing towards unhealthy.

Voice parameter in speech	Rated as healthy voice quality	Rated as less healthy voice quality	Rated as unhealthy voice quality
Hoarse	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
breathy	1,2,3,4,5,6,7,8,9,10,11,12,14, 15,16,17,18		13
hyperfunctional	2,3,4,5,6,7,8,9,1,0,11,12,14, 15,16,17,18	1	
hypofunctional	1,2,3,4,5,6,7,8,9,10,13,14, 15,16,17,18	11,12	
gratings	2,3,5,7,8,9,10,11,13,14,15,16,17, 18	1,4,6,12	
rough	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
voice breaks	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
unstable pitch	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
hard glottal attack	1,2,3,4,5,6,7,8,9,10,11,13,14, 15,16,17,18	12	
vocal fry	1,2,3,7,8,9,10,11,12,14,15,16, 17,18	4,5,6,13	
audible inhalation	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
hypernasality	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
hyponasality	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
Voice parameter in singing	**Rated as healthy voice quality**	**Rated as less healthy voice quality**	**Rated as unhealthy voice quality**
hoarse	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
breathy	1,2,3,4,5,6,7,8,9,10,11,12,14, 15,16,17,18	13	
hyperfunctional	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
	1,2,3,4,5,6,7,8,9,10,11,12,13,14,		

hypofunctional	15,16,17,18		
gratings	1,2,3,5,7,8,9,10,11,12,13,14,15, 16,17,18	4,6	
rough	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
voice breaks	1,2, 3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18		
unstable pitch	1,3,4,6,7,8,9,12,13,14,16,17,18	2,5,10,11,15	
hard glottal attack	1,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18	2	
vocal fry	1,2, 3,4,5,7,8,9,10,11,12,13,14, 15,16,17,18		
audible inhalation	1,2, 3,4,5,7,8,9,10,11,12,13,14, 15,16,17,18		
hypernasality	1,2, 3,4,5,7,8,9,10,11,12,13,14, 15,16,17,18		
hyponasality	1,2, 3,4,5,7,8,9,10,11,12,13,14, 15,16,17,18		

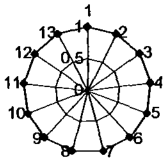
Table 5.11: Distribution of ratings for separate voice parameters for individual children in speech and in singing (numbers in the boxes represent the identification numbers of each individual child

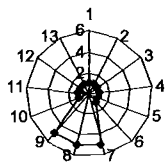
---

Figure 5.6: Radar-charts for individual children. In all the figures, the following numbering on the outer circle was used in representing the following voice parameters: 1= hoarse, 2=breathy, 3=hyperfunction, 4=hypofunction, 5=gratings, 6=rough, 7=voice-breaks, 8=unstable pitch, 9=hard glottal attack, 10= vocal fry, 11=audible inhalation, 12=hypernasality, 13=hyponasality. The numbering on the inner line was used to represent the scale of the voice ratings. The scale was: 1-3 healthy; 4-5= less healthy; 6-7= healthy)

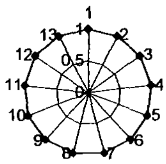
Individual 1: speech (left figure) and singing (right figure)

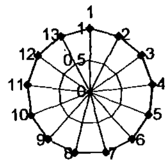
Individual 2: speech (left figure) and singing (right figure)



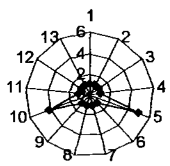


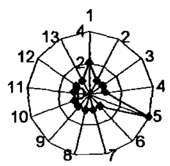
Individual 3: speech (left figure) and singing (right figure)



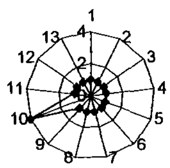


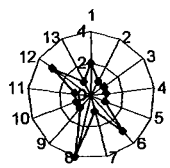
Individual 4: speech (left figure) and singing (right figure)



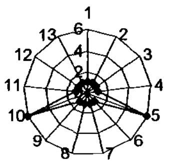


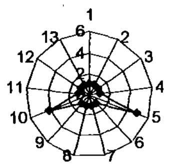
Individual 5: speech (left figure) and singing (right figure)



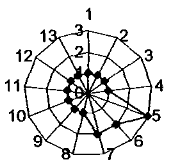


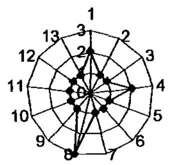
Individual 6: speech (left figure) and singing (right figure)



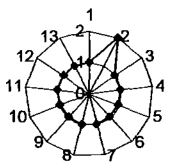


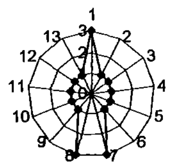
Individual 7: speech (left figure) and singing (right figure)



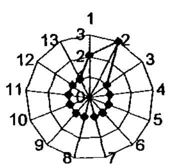


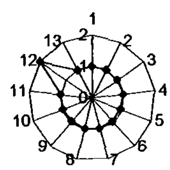
Individual 8: speech (left figure) and singing (right figure)



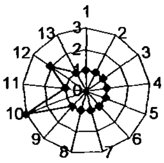


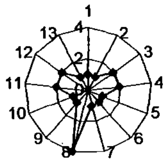
Individual 9: speech (left figure) and singing (right figure)



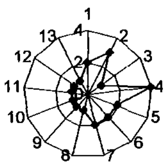


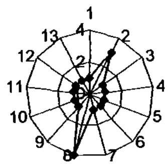
Individual 10: speech (left figure) and singing (right figure)



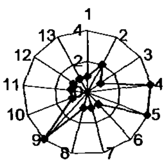


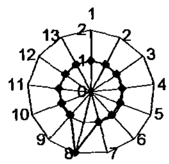
Individual 11: speech (left figure) and singing (right figure)



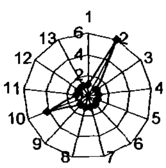


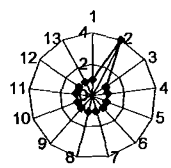
Individual 12: speech (left figure) and singing (right figure)





Individual 13: speech (left figure) and singing (right figure)





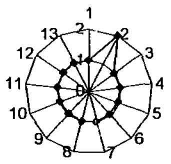
Individual 14: speech (left figure) and singing (right figure)

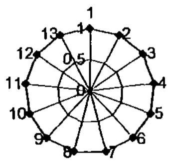
Individual 15: speech (left figure) and singing (right figure)

Individual 16: speech (left figure) and singing (right figure)

Individual 17: speech (left figure) and singing (right figure)

Individual 18: speech (left figure) and singing (right figure)





5.6.2 Healthy characteristics

Several parameters were rated as healthy in speech for the whole class of the children (see Figures 5.5 and 5.6; see Table 5.11). These parameters were: hoarseness, roughness, voice breaks, unstable pitch, audible inhalation, hypernasality and hyponasality.

A greater number of parameters were rated as healthy in singing for the whole class of the children. These parameters were: hoarseness, roughness, hyperfunctioingl, voice breaks, unstable pitch, audible inhalation, hypernasality and hyponasality. Such findings indicate that, overall, the children possessed healthy voice quality in both speaking and singing behaviours.

5.7 Perceived speaking and singing competencies

Similarly to the previous studies, the influence of the children's speaking and singing competencies on their overall voice quality in both vocal behaviours was investigated. The children's speaking and singing competencies were assessed with the use of a specially designed protocol (see Chapter Three and Appendix 1 for the protocol). The data were analysed as in the previous studies (see Section 7.1 for more details on the analyses).

The correlation between perceived speaking competency and overall voice quality in speech was statistically significant ($r=-0.476$, $p<0.05$) (see Figure 5.7 below and Table 5.12). It was negative, indicating that the higher the level of one's speaking competency was, the worse the overall quality of ones voice in speech was.

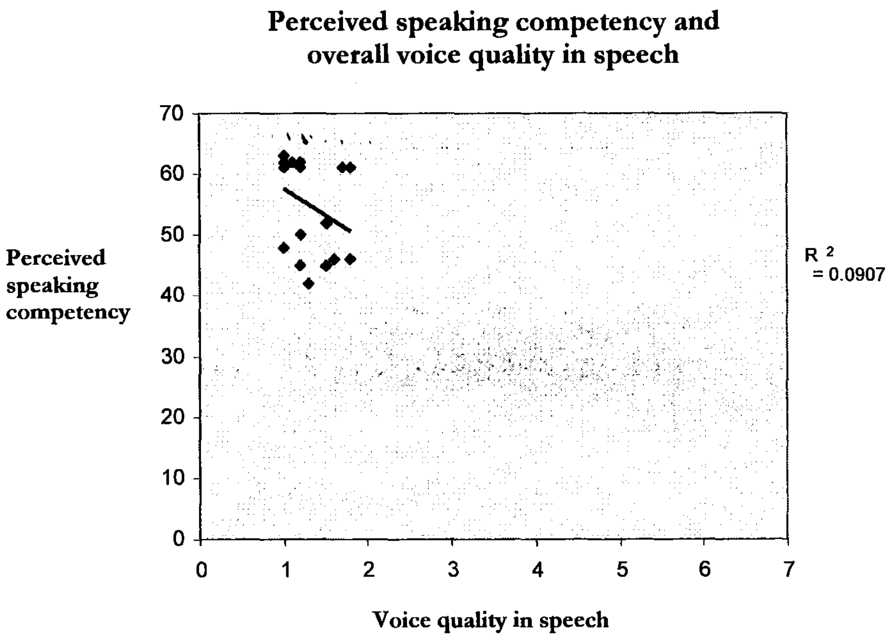


Table 5.7: Correlation between perceived speaking competency and overall voice quality in speech

			voice quality in speech in reading	level of speaking competency
Spearman's rho	voice quality in speech	Correlation Coefficient	1.000	0.476
		Sig. (2-tailed)	.	.036
		N	22	22
	level of speaking competency	Correlation Coefficient	0.036	1.000
		Sig. (2-tailed)	.379	.
		N	22	22

Table 5.12: Correlation between speaking competency and overall voice quality in speech

The correlations between: perceived speaking competency and overall voice quality in singing (r=0.527, n.s.); perceived singing competency and overall voice quality in singing (r=-0.705, n.s.); and perceived singing competency and overall voice quality in speech (r=0.154, n.s.) were not statistically significant (see Tables 5.13-5.15).

			level of speaking competency	singing a song
Spearman's rho	level of speaking competency	Correlation Coefficient	1.000	-.143
		Sig. (2-tailed)	.	.527
		N	22	22
	singing	Correlation Coefficient	-.143	1.000
		Sig. (2-tailed)	.527	.
		N	22	22

Table 5.13: Correlation between speaking competency and overall voice quality in singing

			level of singing competency	voice quality in speech in reading
Spearman's rho	level of singing competency	Correlation Coefficient	1.000	.315
		Sig. (2-tailed)	.	.154
		N	22	22
	voice quality in speech	Correlation Coefficient	.315	1.000
		Sig. (2-tailed)	.154	.
		N	22	22

Table 5.14: Correlation between singing competency and overall voice quality in speech

			singing a song	level of singing competency
Spearman's rho	singing	Correlation Coefficient	1.000	.086
		Sig. (2-tailed)	.	.705
		N	22	22
	level of singing competency	Correlation Coefficient	.086	1.000
		Sig. (2-tailed)	.705	.
		N	22	22

Table 5.15: Correlation between singing competency and overall voice quality in singing

5.10 Summary

The main finding was that the higher a child's perceived speaking competency was, the unhealthier his/ her overall voice quality was. Such a finding indicates that a higher ability in speaking may have a deteriorating effect on the quality of the child's voice in speech.

5.11 Psychological factors

Data for psychological background factors were not gathered for this particular group of participants since the questionnaires used for gathering the data were regarded as consisting of too complicated a nature in order for seven-year-olds to be able to fill them. The decision to exclude this part of the study with this particular group was made by the researcher and the children's classroom teacher.

5.12 Sociological factors

Data for sociological background factors were gathered the same way as in the previous studies (see Section 9.1). The findings were divided into two categories: sex and age. The remaining categories were excluded from the analyses since, as with the section for psychological factors, the children were not regarded as being old enough in order for them to be able to fill in the designed questionnaires.

Linguistic background was excluded from the analyses due to the fact that all of the children in this particular group spoke Finnish as their first language. Socioeconomic background was excluded from the analyses since such information was regarded as of too confidential nature by the head teacher of the school. The decision to exclude these factors from the study was made by the researcher and the head teacher of the school.

5.13 Sex

The histograms below illustrate the distribution of the overall voice quality ratings in speech and those in singing for boys and girls (see Figure 5.8). There were no significant differences between the voice quality ratings provided for boys and those provided for girls. The non-parametric statistical analyses confirmed the finding since they were not statistically significant (for speech: z=0.819, n.s.; for singing: z=0.944, n.s.) (see Tables 5.16-5.17).

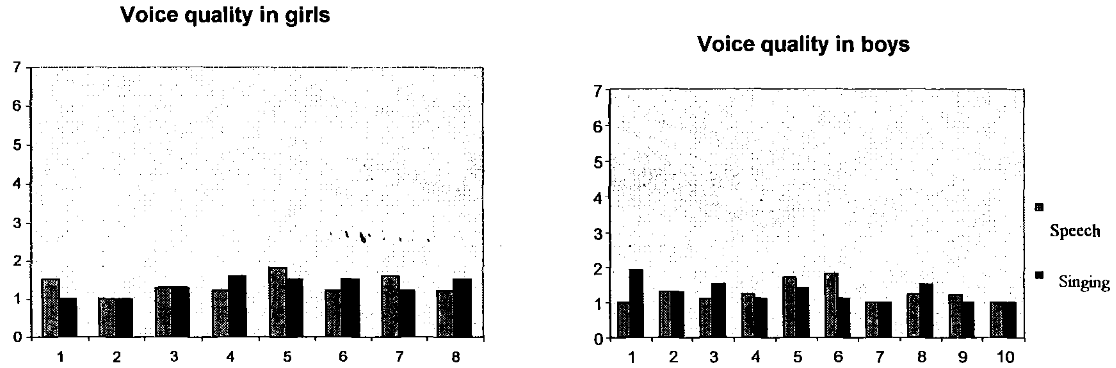


Figure 5.8: Relationship between gender and voice quality

		voice quality in speech in reading	singing a song
Most Extreme Differences	Absolute	.455	.273
	Positive	.000	.182
	Negative	-.455	-.273
Kolmogorov-Smirnov Z		1.066	.640
Asymp. Sig. (2-tailed)		.206	.808

Table 5.16: Kolmogorov-Smimov test for comparing overall voice quality in speech and in singing between boys and girls

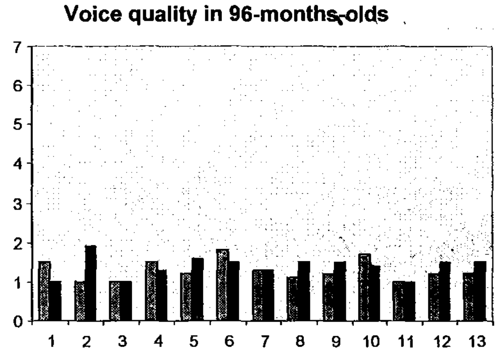
		singing	voice quality in speech
Most Extreme Differences	Absolute	.250	.300
	Positive	.250	.300
	Negative	-.100	-.075
Kolmogorov-Smirnov Z		.527	.632
Asymp. Sig. (2-tailed)		.944	.819

Table 5.17: Correlation between overall voice quality and sex

5.14 Age

The children in this class were between seven and eight years of age. The ages of the children were calculated in months in order to investigate whether age had a significant effect on the overall quality of the children's voices. Their ages were rounded up in months either to 84 (i.e. seven years) or 96 (i.e. eight years), as indicated by the children, since the exact birthdates for all the children were not known.

There was no statistically significant correlation between the age of the children and their overall voice quality in speech (r=-0.110, n.s.), whilst there was a statistically significant correlation between overall voice quality in singing and age (r=0.501, $p<0.05$) (see Figure 5.9 and Tables 5.17-5.18). The correlation was moderately strong and positive, indicating that the older the child was, the healthier his/ her overall voice quality in singing was.



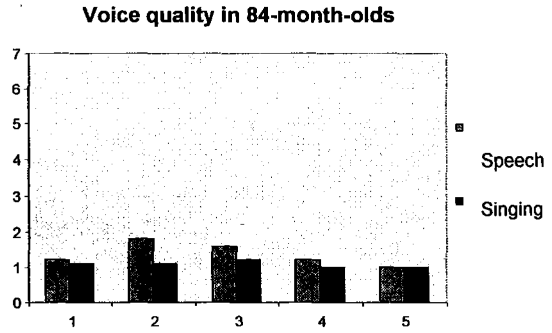


Figure 5.9: Histograms for overall voice quality ratings in speech and those in singing for 96-moth-old children and 84-month-old children

			age in months	voice quality in speech reading
Spearman's rho	age in months	Correlation Coefficient	1.000	-.110
		Sig. (2-tailed)	.	.663
		N	18	18
	voice quality in speech	Correlation Coefficient	-.110	1.000
		Sig. (2-tailed)	.663	.
		N	18	18

Table 5.9: Correlation between overall voice quality in speech and age

			singing	age in months
Spearman's rho	singing	Correlation Coefficient	1.000	.501(*)
		Sig. (2-tailed)	.	.034
		N	18	18
	age in months	Correlation Coefficient	.501(*)	1.000
		Sig. (2-tailed)	.034	.
		N	18	18

Table 5.10: Correlation between overall voice quality in singing and age

5.15 Summary

The main finding was that age had an effect on the overall quality of the children's voice in singing. It appears that the older the child is, the healthier his/ her overall voice quality in singing is. However, age did not appear to have the same effect on the overall quality of the children's voices in speech.